

EIGHTY-FIRST YEAR

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The Air Races of 1925

Interest in Aeronautics Is Shifting from Speed to Utility

By Alexander Klemm

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THE Pulitzer Trophy race and the nine varied contests which accompanied this classic race constituted perhaps the most important aeronautical event of the year. With nearly a hundred contest planes of every possible type, ranging from the tiny air "flivvers" to the giant two-Liberty engined bombers, the 1925 races provided as usual thrills aplenty, and what is more, valuable information and suggestions to inventors, designers and fliers alike. In our brief story we can touch only upon a few of the year's outstanding achievements.

French Plane Skillfully Trussed

The appearance at the races of the Ford all-metal airliner in the role of a department-store delivery truck was a portent of the times. The illustration on page 367 shows the remarkably clean design of the plane, with its huge cantilever wing and roomy fuselage. It has a cabin space of over 280 cubic feet, so that the bulkiest packages can be carried without crowding, and with 1,500 pounds of commercial pay load and 150 gallons of gas, the Ford airliner has for several months maintained an average speed of 96 miles per hour between Cleveland and Detroit.

Edsel Ford and the Ford company executives, after a conference with Rodman Wanamaker, have planned a service to start in a few weeks which will put at

least one plane into daily operation each way. Although not as spectacular as the Pulitzer contest, the visit of the John Wanamaker 1 to Mitchel Field is perhaps a more significant memory.

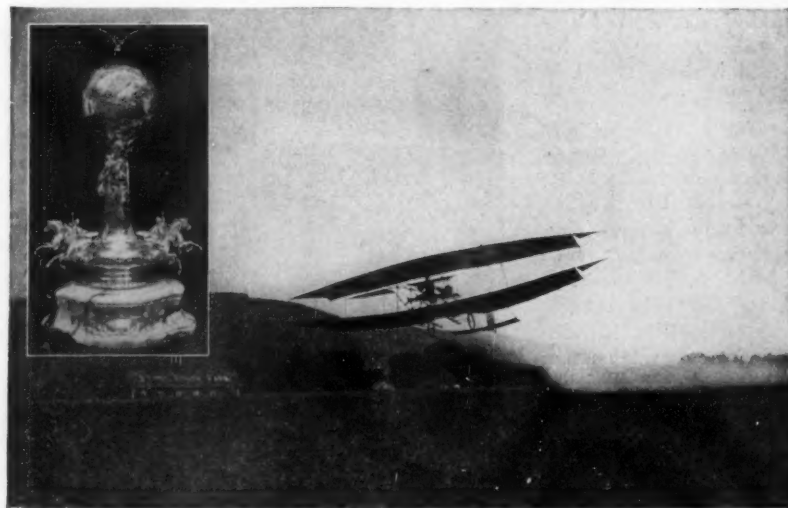
In the one international contest for two-seater Corps Observation type airplanes, the United States lost. It was poor consolation that the fastest of the Army Air Service's observation planes were not in the race. The two Breguets entered by the French War Department were splendid craft piloted by master aviators, Captain Henri Lemaitre and Captain Pelletier D'Oisy of Paris-to-Tokio fame. It was Lemaitre who won, since his plane carried the more powerful Renault motor of 463 horsepower. His speed averaged 129.1 miles per hour over the 189 mile course. But it was not the power of the motor (although this was greater than that of any American motor in the race) nor his skill alone, that carried Lemaitre to victory. It was also the great skill shown in the design of the Breguet, which was studied carefully by engineers at the field. A few points: Since the upper wing is more efficient than the lower, why not make it a little larger? This is done on the Breguet. Since the Corps Observation machine must carry guns, cameras, wireless and other equipment, why not make the fuselage large and comfortable and compensate for its large cross-sectional area by perfect streamline? This is what the Frenchmen have done, giving unusual size but perhaps less head

resistance for the fuselage than in American-built planes. Finally, as our illustration shows, the Breguet is skilfully trussed. A single interplane strut of I form carries the load from the upper wing to the lower, and from there two wires take the load to the wheel, while the same two wires brace the chassis sideways. The wing truss of the Breguet is thus reduced to an absolute minimum. French skill in plane design is worth serious study.

Struts as Lifting Elements

Speed is not the only objective in modern aviation. Efficiency in the form of the greatest possible commercial pay load for a given horsepower is much sought after by designers and constructors. The Aviation Town and Country Club of Detroit Trophy race is an excellent measure of progress in efficiency. In this race a number of cash prizes are awarded annually for speed, but the more important prizes from the engineer's point of view are those awarded for the highest Figure of Merit. This is calculated by multiplying the average speed in the race by the weight of passengers and luggage carried, and dividing this product by the horsepower. A little reflection will show that this is indeed a measure of efficiency, since the prize goes to that plane which can carry the greatest commercial load, at a high speed, for the minimum horsepower.

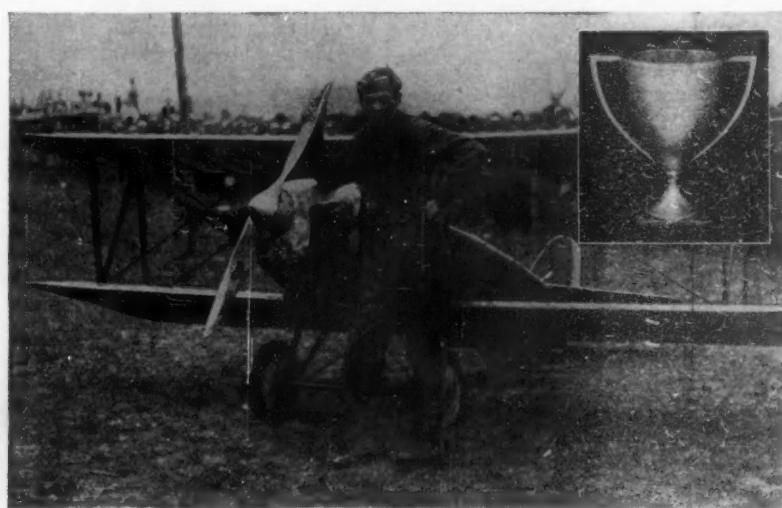
The race, flown over 100 miles in 20 laps, is re-



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THE WINNER SEVENTEEN YEARS AGO

The "June Bug" in which Glenn H. Curtiss won the first leg on the Scientific American cup on July 4, 1908, average speed 39.8 miles per hour, 25 horsepower. The cup became the property of Mr. Curtiss in 1910 when he made his famous New York to Albany flight



Courtesy New York World

THE 1925 CUP AND WINNER

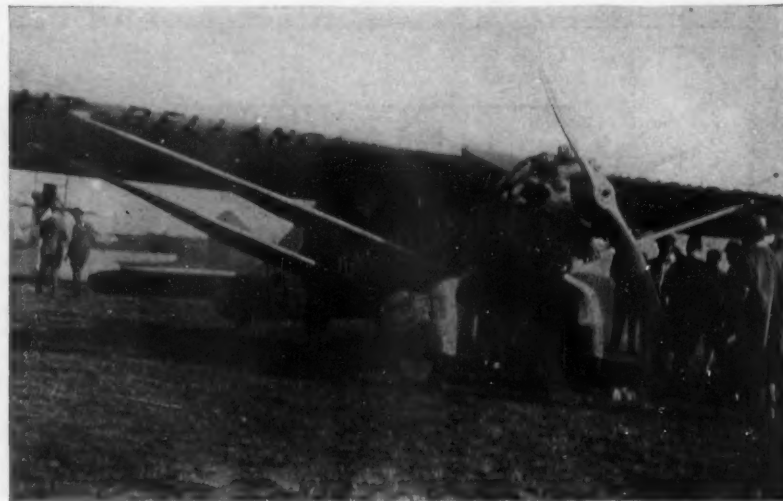
The tiny Powell biplane equipped with the latest type of duralumin propeller. Its pilot, "Jerry" Dack, averaged 76.41 miles an hour in the Scientific American Trophy race. It was equipped with a two-cylinder Bristol Cherub air-cooled engine of 16.7 horsepower



Courtesy New York World

BUILT TO BREAK RECORDS AND WIN TROPHIES

Lieut. Cyrus Bettis with his winning Pulitzer racer which averaged 248.99 miles per hour. His plane was equipped with the new V-1400 Curtiss motor weighing only 660 pounds and designed to turn up 2,500 revolutions per minute



EXCELLENT EXAMPLE OF AERODYNAMIC "CLEANNESS"

The Wright-Bellanca which won the efficiency race for passenger-carrying planes of less than 200 horsepower. The landing gear, on the cantilever principle, has no external reinforcements. The wheels are encased in a streamline casing

stricted to planes of not more than 200 horsepower, but carrying at least two passengers (340 pounds) with their baggage (100 pounds). The efficiency scores of the nine planes that finished this race aroused great interest and the winning planes—a Wright-Bellanca, a modified Curtiss-Oriole and the Sikorsky S-31-A—deserve some little attention.

At the 1924 races in Dayton, the highest Figure of Merit was 430 points obtained by a three-seater Swallow with a 90-horsepower OX-5 motor. The Wright-Bellanca achieved 602 points this year and occupied quite a respectable place as far as speed is concerned, finishing third with an average of 112.0 miles per hour. There is no doubt that the new Wright-Bellanca marks real progress in the art. It is equipped, first of all, with an air-cooled motor, the Wright J-4, which delivers 200 horsepower, yet weighs only 467 pounds, and with the air-cooled motor no heavy radiator and cooling water is carried. As a result, the Wright-Bellanca is light, weighing only 1,750 pounds, empty of fuel, oil and occupants, and can carry a complement of pilot and five passengers and several hours' fuel without overloading.

The cabin of this plane is roomy but it is all enclosed, so that the resistance of the large fuselage is comparatively small. For entire external bracing the wing has but two struts on either side, and these struts are so designed that they are themselves lifting elements. In this we have one of the most refined points in the aerodynamic design of aircraft

and there is no doubt that the practice of using lifting struts will be widely followed. Finally, the designer has carried the landing gear to the ultimate refinement of streamline. In our illustration it can be seen that the landing gear is built on the cantilever principle, with its sturdy legs, tapering from base to tip, unreinforced by any external wires, and that the wheels themselves are almost hidden in a streamline casing.

Even the ultra-scientific airplane race leaves ample room for the personal equation. How else did "Casey" Jones in his Curtiss-Oriole finish first in speed with 128.4 miles per hour, and achieve second place in efficiency, with 394.8 points, while another pilot in a Curtiss-Oriole turned up but 105.8 miles per hour and only 251.4 points in efficiency? "Casey" is a perennial winner of prizes, and it is "Casey," and not his already well-known Oriole that we wish to honor in our photograph. His technique in the air is perfect and the peculiar way he has of cutting around the pylon at a steep bank leaves the spectators thrilled on every lap.

The Sikorsky, an excellent plane with a speed of 93.16 miles, took third place in efficiency with 392.9 points. But it showed nothing like the originality nor the performance of the Wright-Bellanca. We include it in our scanty space, not because it is striking, but because it is typical.

Limit of Speed Not Yet Reached

Nothing attracted more interest at the races than the Scientific American Trophy race, restricted to planes with engines of less than 80 cubic-inch displacement or something under 20 horsepower. There is a universal appeal in these "baby" planes, often built under difficulties and avowing of the "home-made" article. In this particular event a series of prizes for speed were awarded, and an equal number for efficiency—efficiency being measured by dividing average speed over the course by the gasoline consumed. Some progress in speed over last year's races was shown, and trouble due to insecure bracing of the high-speed engines and poor gearing between the drive shaft and the propellers, had disappeared. The art of installing motorcycle engines in light planes has been learned by the contestants.

The tiny Powell plane was the winner of the Scientific American cup. Its pilot, "Jerry" Dack, maintained a steady average speed of 76.41 miles an hour over the 50-mile race, with an engine of only 67 cubic-inch displacement; that is, well under 20 horsepower. Its Figure of Merit was 1.415, and its fuel consumption was 54 gills. With a wing spread of 15 feet 9 inches, a 32-inch chord and a

total area of 67 square feet, the Powell plane weighed only 320 pounds when empty. Nothing could be neater and cleaner than this little biplane which showed a clean pair of heels to all the monoplanes that followed it. It is a curious fact that just as the fastest racer built in America is the Curtiss biplane, so the fastest baby plane in the United States is likewise a biplane.

The Johnson Airplane and Supply Company of Dayton secured the second place with their *Bumblebee*, changed but little from the races of last year at Dayton. The average speed of 69.66 miles per hour maintained by the *Bumblebee* seemed to impose not the slightest strain on a small, four-cylinder, Henderson, motorcycle engine. The steel propeller is displacing the wooden propeller not only on the fast military planes but even on the baby planes, and it showed up very well on the *Bumblebee*.

For those of our readers who may be ambitious to build such a monoplane for themselves, we shall give a few dimensions: Span of wing, 27 feet; overall length, 15 feet; area, 77 square feet; wing section U. S. A. 45, tapering gradually from root to tip of wing; weight, empty, 330 pounds. The wing is continuous across the top of the fuselage and, as it is mounted with only four bolts, it is demountable in five minutes. Careful cowling in of the engine, with louvers directing the air flow towards the hottest parts of the cylinders, was a feature of this design.



Courtesy New York Evening Post

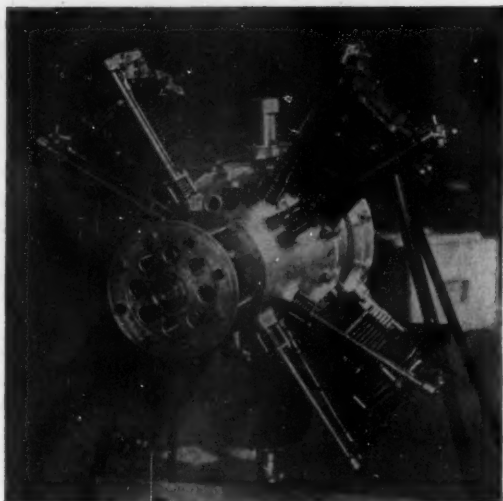
A PERENNIAL WINNER OF PRIZES

The jaunty, golf-knickered "Casey" Jones who wins at least one prize at every meet with his special Curtiss-Oriole and scored twice this year



EQUIPPED WITH A MOTOR-CYCLE ENGINE

Emrich, who flew second in the Scientific American Trophy race, standing proudly by the side of the *Bumblebee* built by the "Johnson boys" at Dayton



A NOVEL AIR-COOLED ENGINE

The Caminez or Cam engine, in which crank arm and connecting rod are replaced by pistons working through roller bearing on a large cam

While these planes showed nothing remarkably new, yet the mere disappearance of engine trouble, the quicker get-aways, as compared with last year, showed that these planes are better understood and are approaching the point where they may become a training school for more ambitious design.

The Pulitzer racers, built to break records and win cups, are not adapted to military uses as they emerge from a contest. But they are a splendid introduction to the army pursuit ships, a most important unit of an air force. Carrying as they do only a pilot and two fixed machine guns, second in speed only to the racers, the pursuit ships form the advance guard of an air force; they are the first to engage an enemy after the declaration of war, they enfilade his troops with machine-gun fire or they engage his invading air squadrons, attacking the slower bombing or reconnaissance machines. And if we study the group of splendid pursuit ships which came from Selfridge Field to Mitchel Field we see that they are the direct derivatives of the racers, with such minor changes in design as, for example, a larger body to accommodate the machine guns and more wing area to compensate for extra weight.

In the John L. Mitchell Trophy race eight crack army pilots each flew an identical pursuit plane. Not only the honor of winning the trophy, but also the honor of being the Army's representative in the next Pulitzer race awaited the winning pilot. No wonder that these wonderfully alert young pilots strained every nerve to win! While the speed of the pursuit planes seems slow by comparison with the

racers, the 161.5 miles an hour of the winner, Lieut. T. K. Matthews, is a wonderful figure for a military plane carrying full equipment.

Year by year the speeds attained in the Pulitzer race have increased until it is asked what the ultimate limit of speed will be! The following table gives the average speeds year by year over the 124.27 miles of this classic race:

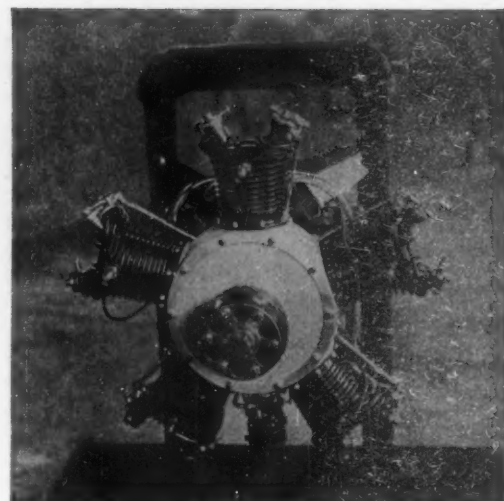
Year	Miles per Hour
1920.....	156.5
1921.....	176.7
1922.....	205.8
1923.....	243.68
1924.....	215.72
1925.....	248.99

No new racing planes were entered in 1924. This year's race represented, therefore, two years' development. It showed greater speed, but not startlingly so. And there were no striking developments in the design of the plane itself. Apparently, for the time being, the ingenuity of designers had been baffled; wings could not be made much more efficient, and the remarkable streamlining of the planes had not been improved. Progress was almost solely in the engine. The Curtiss D-12 engine with its 500-horsepower engine and weighing only 660 pounds had been replaced by the Curtiss V-1400 rated at 619 horsepower, or only 1.1 pounds per horsepower. The V-1400 did not show up as well as had been expected, but nevertheless it is a wonderful achievement in automotive engineering.

While the Curtiss Pulitzer racer has often been described, we cannot resist the temptation of giving its wonderful characteristics. The biplane measures only 22 feet between wing tips. The body is 19 feet 8½ inches in length and tapers back from the nose to the tail in perfect streamline form. The single, solid, wood strut which separates and supports the upper and lower wings on either side of the body offers the absolute minimum of resistance for its cross-sectional area. The number of exposed wires is reduced to a minimum. The radiator offers no extra resistance because it is a part of the upper wing itself. Although made of brass only .004 inch thick, it permits a flow of 45 gallons per minute, which keeps the powerful engine cool even while it is running wide open during an entire race.

One Pound Per Horsepower

Last year the Scientific American commented adversely on the use of a wooden propeller during the Pulitzer race, and in many quarters this was regarded as the cause of the terrible disaster to Captain Skeel. No such criticism could be made this year. The Reed-Curtiss propeller employed on both the army and navy Pulitzer racers, was made



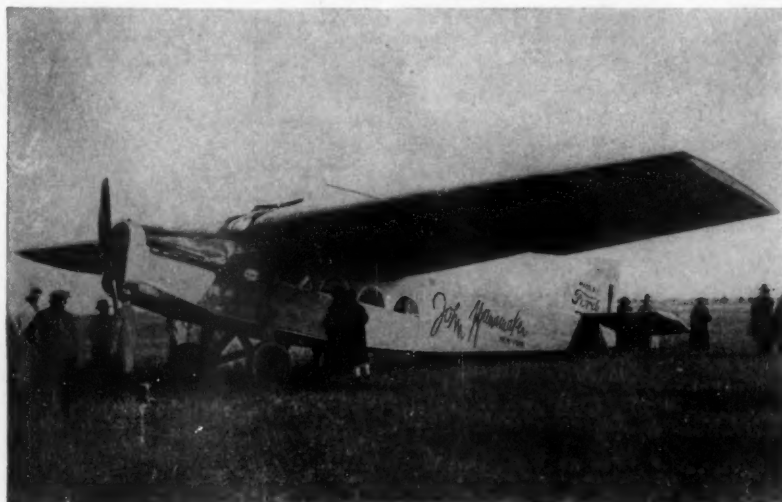
ANOTHER AIR-COOLED ENGINE

The five-cylinder air-cooled engine of seventy horsepower built by the airplane division of the Rickenbacker Motor Car Company

from a solid block of forged duralumin. It does not warp or deteriorate under varying climatic conditions, cannot be broken or pitted by hail, rain, et cetera, and is probably one of the few types of air screws capable of withstanding the terrific strain of modern racing. It was whirled round at nearly 2,400 revolutions per minute throughout the race and has been pronounced the most efficient propelling screw designed for use in the air or in the water. It has a calculated efficiency of 89 percent, while the average water screw is only about 50 percent efficient. This wonderful propeller had a ten-foot pitch in the racer, pulling the plane forward almost ten feet with each revolution.

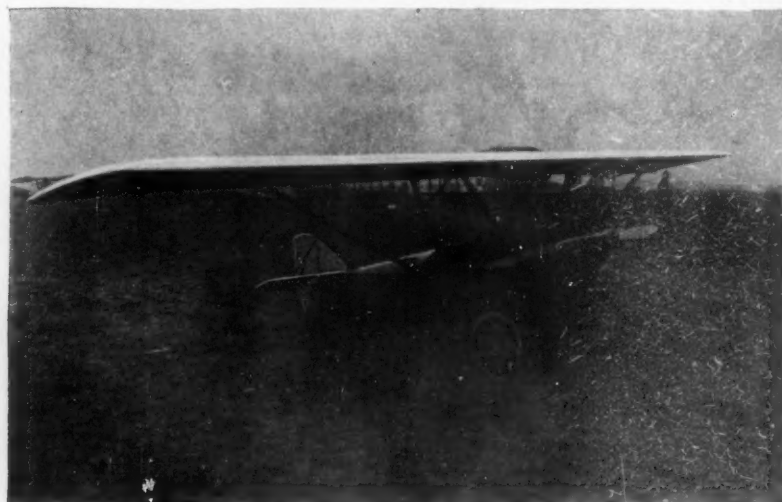
In contrast to former races the pilots of the latest Pulitzers did not take off without safeguards. Heretofore when the engine stopped at an awkward point, it was up to the pilot to bring his plane down no matter how difficult this might be. In the 1925 racers the pilots wore a parachute. Its use has been made possible by an arrangement whereby the pulling of a lever throws open the upper part of the narrow and almost enclosed cockpit, giving sufficient clearance for a jump. Even if flying low, the racer pilot can use his chute. Such is the terrific momentum of this type of craft, that if trouble occurs, he can pull back on his stick and "zoom" up to a height of 1,500 feet or more from where he has plenty of height to jump with full assurance that his chute will open up comfortably.

There was nothing to choose between the Navy's champion, Lieut. "Al" Williams and the Army's



A PORTENT OF THE TIMES

The Ford Airliner, a roomy and speedy monoplane purchased by the John Wanamaker stores to establish a winter express service between New York and Florida



THE DORMOY FLYING BATHING MACHINE

Dormoy managed to come in third in the speed and efficiency contest. Outside of his engine he spent scarcely more than a hundred dollars on the entire outfit

quiet, but efficient pilot, Lieut. Cyrus K. Bettis. If Williams did not repeat his exploit of 1923, and finished several miles behind Bettis, it was not for lack of skill, but because his motor stood up less well under the terrific strain. It is demanding a tremendous amount from even the finest piece of machinery, weighing only 660 pounds that it shall deliver over 600 horsepower.

Of the 12 high-compression, V-1400 engines built by the Curtiss company it would appear that only the one flown by Bettis actually turned up over 600 horsepower on the block, and even this engine did not turn up the 2,500 revolutions per minute expected of it during the race. Much higher engine speed and plane speed were expected, and the results were somewhat of a disappointment to both services. Serious consideration will undoubtedly be given immediately to the problem of securing the rated power.

The average speed of this Pulitzer race falls far behind the French record, made by Benett last December in a Ferbois monoplane, of 278 miles per hour. But that record was made over a straight, short course of three kilometers, while in the Pulitzer race, pilots lose time in their initial climb and in turning around pylons. While speeds of 300 miles an hour were reported in the trials, these were obtained only by initial dives to get extra speed, and the highest American speed over a local straight-away is around 260 miles per hour. There is this to be said for American design, however, and that is, that the French racer had no limitation imposed upon it as regards minimum speed, its landing speed being 100 miles per hour; whereas with the Pulitzer racers a landing speed of not more than 75 miles is obligatory, and lower landing speed of necessity entails lower maximum speed.

Advantages of the Air-cooled Motor

In spite of the somewhat disappointing results of the race we do not think that the limit of speed has been reached. Ingenuity will be used to pass from the biplane to the even cleaner monoplane, and improvements in general streamline and engine power will surely come. Perhaps it will be human limitations which will put an end to greater speed records. In 1923 Williams lost consciousness for several seconds on sharp turns. This year he made long sweeping curves at the pylons to avoid the tremendous pressure of centrifugal force on the blood of the brain.

One of the great lessons of the 1925 air races is that the air-cooled motor has come to stay. The frequent and entirely successful use of the Wright-J engine (the Whirlwind) as in the remarkable performance of the Wright-Bellanca, and the gossip of pilots and mechanics, all substantiate this conclusion.



THE INTERNATIONAL CONTEST WINNER
Captain Lemaître's French Breguet which beat the American Corps Observation planes. The radiator under the nose of the ship can be drawn in when the weather is cold, and less cooling is required

Therefore, it was all the more interesting to see two new air-cooled engines announced at the races, the Rickenbacker and the Caminez.

The Rickenbacker engine is a conventional five-cylinder engine of some 70 horsepower. This is all the definite information yet available. Far more significant is the fact that the Rickenbacker Motor Company is going frankly into the construction of aero engines on a production basis.

In the Exhibition hangar at Mitchel Field, was shown perhaps the most interesting and certainly the most novel air-cooled aviation motor of the day. This was the four-cylinder Caminez engine, differing radically from any previous air-cooled design.

In any ordinary four-cycle, internal-combustion engine, the piston of a cylinder makes two strokes for one revolution of the crankshaft—the little end of the connecting rod swinging around a complete circle with the crank pin while the piston moves up and then down.

In the Caminez, by a daring conception, the crankshaft carries a large cam whose surface actuates the up and down motion of the pistons through roller bearings, the four pistons being connected by a Scotch yoke. This mechanical conception, while not new, is entirely novel in application to the internal-combustion engine. It is possible to arrange the cam surface in such fashion that the pistons now make four strokes for one revolution of the engine. From this one mechanical result, a great many advantages follow:

For the same piston speed as in the conventional

internal-combustion engine, the crankshaft can run at half speed. Therefore, it is possible to employ the highest piston speed without an excessively long stroke and yet maintain the revolutions of the propeller at a low figure. The airplane engine when driven at high revolutions per minute is altogether too fast to secure the highest propeller efficiency. Gearing down the motor means both weight and complication, and some loss of reliability owing to the introduction of fast moving, comparatively light, gear wheels. In the Caminez, the low propeller speed, secured without the introduction of gearing, is an important advantage.

Owing to the fact that four piston strokes are obtained per revolution, the valve-operating cams can be mounted directly on the drive shaft, and thus timing gears are dispensed with.

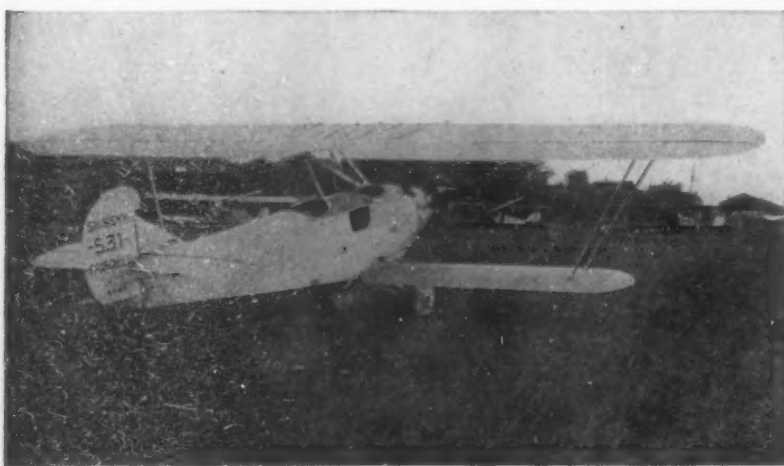
Since no long connecting rod and crank are required, it is possible to bring opposing cylinders much closer together than in the conventional, radial-type, air-cooled engine. This means that the engine has a smaller frontal area, does not project far outside the fuselage; and the vision is considerably improved thereby.

Compactness of the engine brings lightness as a logical consequence. The number of parts and production costs are considerably reduced by the elimination of the valve gears.

When the engine was first built at McCook Field it was feared that the roller bearings on the large cam would give trouble. But a 50-hour, continuous test at full power has dispelled this apprehension, and examination of the engine shows very little wear.

Our Aviation Will Not Lag Behind Europe's

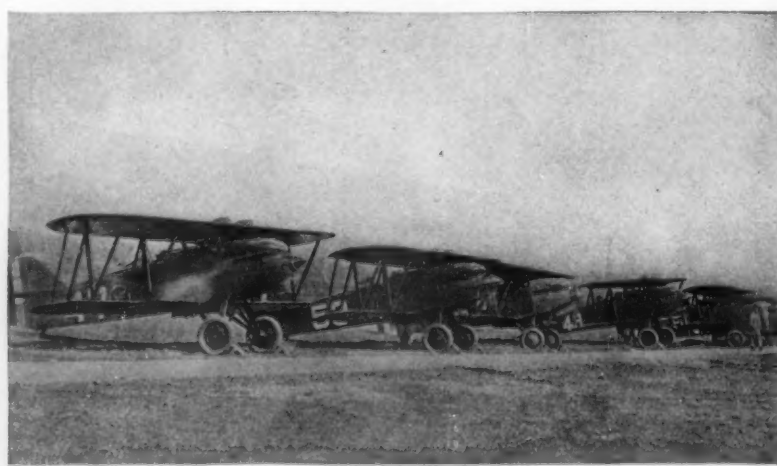
Perhaps the outstanding impression of the races was that the center of interest in American aeronautics was shifting from the extremely high-speed racer to the slower, but more generally useful transport plane. The Pulitzer racers have slowed up in their onward sweep towards greater and greater speeds. Henceforth every extra mile will be painfully gained, the law of diminishing returns will be in evidence. But with the success of the air mail, with the granting of contracts for air-mail carrying by private operators, the American transport plane is definitely coming into its own. The Stout eight-passenger monoplane, the three-engined Fokker with its ten passengers which is described elsewhere in this issue, the wonderfully efficient Wright-Bellanca, these were really the focus of interest if not for the general public, then for serious students of the art. There is no doubt that the American designer has already grasped the secret of successful design for these types and that henceforth American aviation will not lag behind that of Europe.



Courtesy "Aero Digest"

TO WORK FOR UNCLE SAM

The Sikorsky S-31-A, another plane equipped with the Wright-J air-cooled motor. Not so fast or original as the Wright-Bellanca it is a good example nevertheless of the machines that will carry mail on the feeder lines of the transcontinental air mail service



Wiley World

IMPORTANT UNIT OF AN AIR FORCE

A group of United States Army Pursuit planes, the fastest service planes in the world. Lieutenant T. K. Matthews averaged 161.5 miles per hour in one of these in the Mitchell trophy race, winning the race as well as the honor of being the next Pulitzer race pilot

Is the Universe Running Down?

Within the Last Few Years, Vistas Have Been Opened By New Discoveries that Extend the Range About Which We Can Make Predictions by a Thousand-fold

By Henry Norris Russell, Ph.D.

Professor of Astronomy at Princeton University,
Research Associate of the Mt. Wilson Observatory of the Carnegie Institution

TWO months ago we sketched the present interpretation of the evolution of the stars and told how astronomers had come to believe that the very substance of the stars—the matter of which they are composed—is gradually disappearing, and being replaced by the equivalent amount of energy. This is an extremely radical idea, and it is worth remembering that it was accepted only after all other attempts had failed to explain how the sun could have kept shining, without perceptible change of its warmth, throughout the ages of geological time.

From the new point of view that has come with this idea, a billion years appears as but an insignificant fraction of the life of a star—probably no larger a portion than a single day is in the life of a man. Amazement at this prodigious sweep of time is naturally every one's first reaction, and a life of tens of thousands of billions of years at first thought seems eternal. But, as the first surprise passes, and our minds become adjusted to the new idea, it is plain indeed that the life of a star, long as it is, is very decidedly finite. Once we have learned to stretch our imaginations, we can repeat the process, and speak—as Walt Whitman did long ago—of “a few quadrillions of years,” as if that, too, were but a little time.

The End Is Darkness and Cold

What has science to say of the future, if by that word we signify a time so remote that even the life of a star is small in comparison? A few years ago, the answer would have been in this wise: “So far as our knowledge goes, the atoms of matter are indestructible. They may be gathered into different forms but, so far into the future as imagination can reach, they will still be there.”

Even so, however, the physicist would have told us that the universe was gradually “running down,” for heat tends always to flow from the hotter to the colder body, and to escape by radiation from the surfaces of the stars, planets, and all other bodies, and fly off into the outer depths of space where we cannot follow it.

Slowly, then, sometimes very slowly, but steadily, all things must cool down. However great their internal stores of energy, these must ultimately be depleted to the point of exhaustion, so that the final scene of the play shows only cold, dark, bodies, frozen, rigid and lifeless, moving in their orbits in impenetrable darkness.

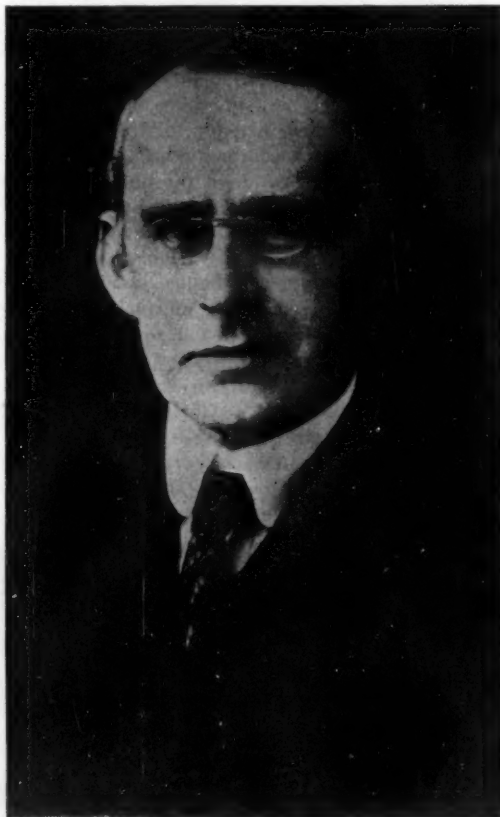
The present text, though drawing out the action of the play, leaves it with a still emptier conclusion. Not only is the stage in darkness and silence, but before the last gleams of light disappear, the principal actors—the stars—have dwindled away to mere shrunken remnants of their old selves. And could the light be turned from without upon the stage there would be little there to see.

Faced with this conclusion, we ask, have we read our text aright? Is there no escape from the conclusion that the universe is running down, and that its multitudinous activities must come to an end?

So far as our present knowledge goes, but one answer seems to be possible. Irreversibility is written wide and deep upon the face of nature. Friction always retards motion and heats the bearing surface.

The reverse action—in which the motion would be speeded up and the bearing cooled—is utterly unknown, and there is no evidence at all that it ever happens. Nor do we ever find, when a hot and a cold body are brought into contact, that the hot one gets hotter and the cold one colder. Again, we find that heat is continually being radiated away into space, and we can detect no heat returning from empty space. All the light or heat that we observe bears marks of having come from hot bodies, and the space between them and beyond is cold and dark.

Most completely irreversible of all would appear to be the newly discovered process by which matter is turned into free energy. Matter exists in the form of atoms and electrons. The best image we can form of its disappearance is the one which Eddington gives. An electron and a proton come together



Underwood & Underwood
PROFESSOR A. S. EDDINGTON
Cambridge University Mathematician and Scientist

under suitable—and very rare and specialized—circumstances, and rush together so violently that they coalesce. The positive and negative charges neutralize one another, while the energy which was previously locked up in the field of force associated with them is liberated in a “splash” of radiation. This radiation is presumably at first very concentrated and enormously intense; but it spreads out with the velocity of light and is scattered by other electrons, losing part of its own energy and setting them in very rapid motion. They collide with still other electrons or atoms—losing speed and setting the others in motion, until the disturbance becomes lost in the general motion of the swarming particles.

Such a process is clearly comprehensible to any-

one who knows a bit of modern physics; but the reverse process, although imaginable, appears infinitely improbable. We should have to imagine a number of electrons all setting successively upon one already fast-moving one in such a way that every collision slowed them up and speeded the fast one. Next we must suppose that a considerable number of electrons were thus set in abnormally rapid motion, in paths that converged toward one point, and at such instants and such speeds that they all reached this point at almost exactly the same time. When they reach this point, the electrons must expend their exceptional energy of motion in setting up waves of radiation so adjusted that they all conspire to form intense concave spherical waves, converging towards a single point. Finally, at this point, the concentrated energy, accumulated, a little at a time, in hundreds or thousands of successive processes, will be great enough to be re-made into an atom. One single failure of adjustment at any stage of this complicated process would prevent its completion, and it is hard indeed to see how it could actually occur.

The formation of atoms out of light, once the light has got out into empty space, is even harder to imagine; for in interstellar space the radiation is feebler, the spaces great, and we know of nothing at all which might start the radiant energy concentrating into small compass.

All that we know, therefore, of the operations of Nature confirms the conclusion that the end is darkness and cold—death so complete that no decay follows.

Our Knowledge Is Far from Complete

But is this really the end of the great drama of Nature? Or does our present scientific knowledge give us but one act in an endless play? Do the lights come on again, and does the action recommence, or does a curtain of endless darkness fall upon the scene of our universe?

No certain answer can be given; and we must be on our guard against a fallacious feeling of certainty. Our scientific knowledge is far from complete and, within the last few years, vistas have been opened by new discoveries that extend the range about which we can make predictions by a thousand-fold. When new knowledge comes—if, for example, the reasons should be found why electrons and protons have the changes and masses which they do—some of the questions which now appear most hopeless may prove soluble. Until then, we must be content with inevitable ignorance.

We may dream, if we will, that the deeper laws of Nature are such that matter rebuilds itself, and the round of change goes on unendingly; or, should we prefer, that the turmoil ends in quiet—and which we choose to dream will depend upon our own type of mind. But of this we may be reasonably assured. Although one discovery be piled upon another, and the extent of our knowledge be far increased, so that we may anticipate the future, and hark back into the more impenetrable past, our explorations will still end in the unknown. Even in the realms of material Nature (and it is, of course, only of these that we speak), we may find more and more, but we cannot find out even Nature “unto perfection.”

My Doubts About Spirit Photographs

By Walter Franklin Prince

Research Officer, Boston Society for Psychic Research

I DO not deny that there are spirit photographs, but "hae ma doots" of pronounced character. Myriad testimonies from individuals, however learned or experienced in anything except "physical phenomena" or conjuring, will never convince me, although they declare, "There was no chance for fraud," "The plates never left my control." We received similar solemn assurances when pictures grew on the Bangs sisters' canvasses in the light, and when Duguid's "spirits" produced in the dark paintings on cards supposed to be infallibly marked. A score of respectable people, including a judge, have told me that Reese revealed what was written on folded slips of paper before he touched them, yet every one was mistaken and I know the psychological groove down which his mind slipped. Hundreds declared that they kept fast hold of P. L. O. A. Keeler's slates, while the spirit writing was being produced, although the essential part of the drama was over when they thought it was just beginning.

Such physical phenomena involve a multitude of little acts on the part of the "medium" which, if he has become by practice even a clumsy magician in his own narrow line, present opportunities for deception which would elude most observers. Nothing short of a successful series of tests by a committee which includes an investigator experienced in "physical phenomena," a photographer familiar with camera trickery and an expert conjurer, ever will or should convince an intelligent public.

William Hope, the English marvel, refuses all tests of this character. W. M. Keeler would not allow me to witness his process even though lashed to a chair. Martin stopped working as soon as he knew that Dr. Hyslop was his sitter. So far as I can discover this is characteristic of all spirit photographers. Their spirits are selectively bashful. They want to prove survival but avoid what would seem the surest method of doing so.

Photography was practiced for twenty years before the first so-called "extra" appeared. We now hear that amateurs get "surprised" by the appearance of

an unexpected face or form on their films. But for twenty years no such unaccountable accident took place. When, however, Mumler of Boston began producing, the accidents rapidly spread. In other words, spirits happening to be present didn't "take" until March, 1861, but after that began to impress plates in various parts of the world. It will probably be explained that they learned the use of a spirit chemical.

Many of Mumler's spirits carried or wore wreaths, bouquets and anchors, sported crowns, and so on. It is understandable that he should have had a taste for such things, but not that spirits so decked should have flocked to him and deserted certain of his later colleagues, and that hardly one of the host of heaven seems to care for wreaths and anchors now. And it is strange that so many a rheumatic or ossified spirit came to his studio to lean upon a sitter like a log, while some other photographers attract healthy and graceful ghosts.

"Psychic Laws" Vary with Photographer

Following Mumler appeared a type of "extra" consisting of a face only, fading out at the edges in moony fashion, a type still often seen. The "psychic laws" had obviously undergone alteration.

There have been photographers like Boursnell, whose spirits appeared impelled to wrap themselves in a long mantle passing over the head. Again, this is understandable on the basis of fancy or method of the individual camera man, but not otherwise in the absence of a sign in the studio: "All spirits entering here must wear Arab costume."

Why do large groups of babies sometimes meet in the studio of Martin, take off their heads and arrange them equidistantly in one thin stratum, but never indulge in this quaint sport in most other mediumistic studios? Did spirits, not Keeler, cut out figures from Hofmann's "Christ in the Temple," trim their beards a bit, and shift them into a different arrangement? Did his *spirits* copy an old picture from the *Cosmopolitan Magazine*? I have an annoying memory for pictures.

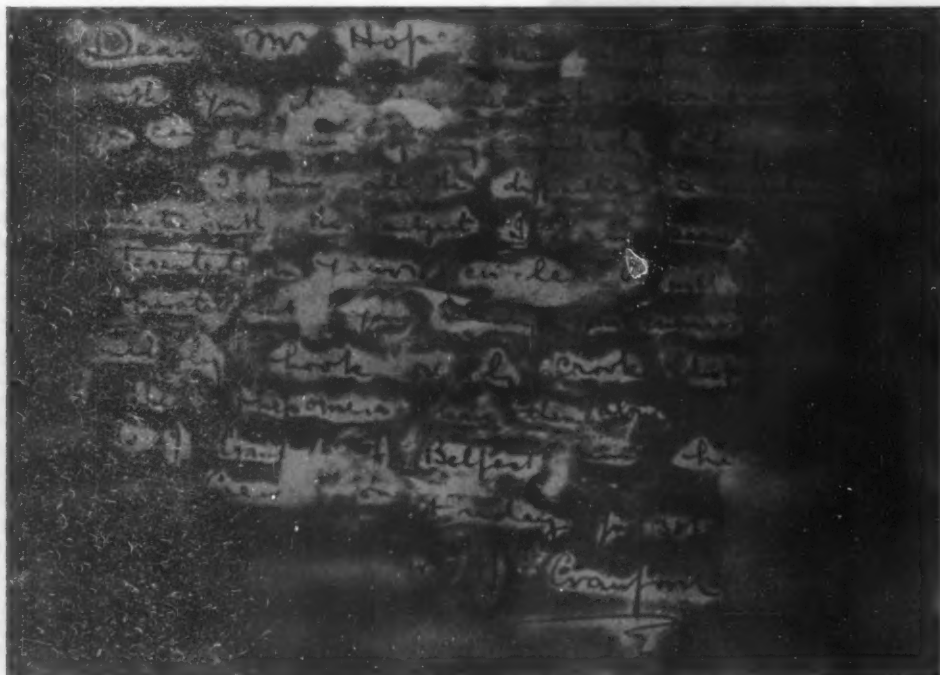
The "ectoplasmic arch" or circle type reached its full development in the "extras" of William Hope, and has since spread and been varied by different photographers. It is popular with British spirits but American spirits, perhaps from patriotic motives, shun it. The ectoplasm looks as though made of gauze, paint or cotton batting, and often by partly obscuring the face helps imaginative persons to recognize it.

Not only do the "psychic laws" vary with the photographer but natural laws are no longer effective. It is very common to find the sitter's and the spirit's faces, supposed to be produced at the same time, throwing shadows in different directions. And if we allow for "psychic light," even this is not consistent with itself. I know no photographer, producing groups of spirits, whose work does not show faces lighted from two, three or even four points. "Ectoplasmic" mantles showing folds and looking as though possessed of weight defy the law of gravitation. Extras not infrequently appear standing on their heads.

Anyone who wishes to see how far the wonders of spirit photography reach should read my study of Keeler's work, enumerating thirty distinct varieties of duplicating (let us call it) the effects which can be produced by fraud. He will meet such curiosities as spirits with wings, and a church in paradise which exactly duplicates a building of the Panama-Pacific Exposition, nude figures in the frieze and all.

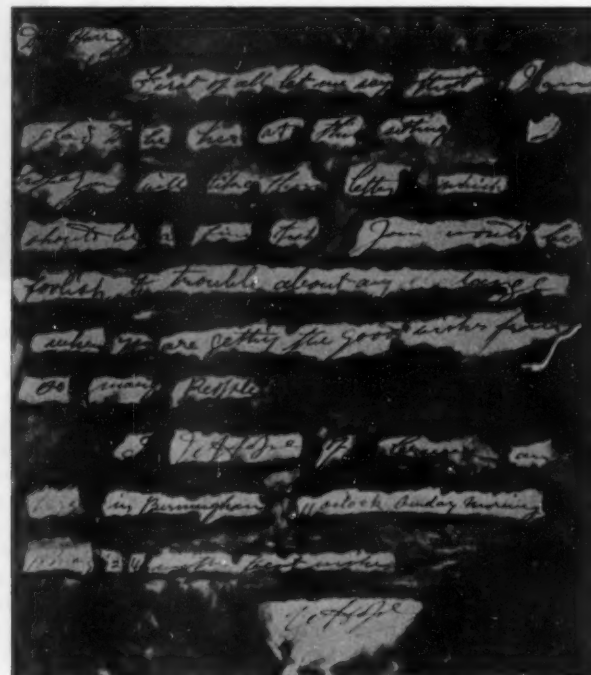
Mumler told of an "extra" which appeared holding a wreath with the word "Millie" within it. I have the old photograph, but the extra has faded out, all but the wreath and "Millie," which, as the nib marks plainly show under a glass, were both done with pen and ink. Did a *spirit* hold the pen?

Doyle has written "The Case for Spirit Photographs"—and if that is the case, heaven help it! Out of ten identifications represented by extras and life pictures, several are very doubtfully more than chance general resemblance in picked cases, and in most instances the account of the surrounding circumstances is fatally defective. One "extra" was



A HOPE PSYCHOGRAPH

This letter was supposed to have been written by Dr. Crawford's spirit. It was compounded, however, from words cut out of his life letters. (Taken from Doyle's "Case for Spirit Photography")



A PRINCE PSYCHOGRAPH

This letter was pieced together by Dr. Prince from words and phrases cut from letters written by Hope



DR. RICHARD HODGSON

The former noted psychic researcher, photographed with an "extra," of the moon type. This was made under his own direction by a normal process

the father of the medium's assistant, another had been a citizen of the medium's own small town. Some of the best stories have since been riddled. One is of a man named Boyd who took a photograph of natives in Africa and, when he developed it, found a woman and child whom he did not remember seeing in the group, while around the woman's head was the "ectoplasmic arch." How did it come to be there, inquires Doyle, unless "there is some definite law which regulates results" (but which definite law, as we have seen, did not begin to operate until forty years of spirit photography had passed)? So far so good, but we are not told that Boyd took more than a hundred pictures before he developed one, and so could not possibly have remembered the composition of every group; nor that the woman fitted perfectly into the group and was of the same tone as her companions; nor that the "arch" was exactly like the linen scarf or mantle worn by the women of that tribe! Other meaty supplements I omit for want of space.

At a lecture in New York Doyle showed a picture of the faces of a dozen firemen who perished in a Chicago fire, thrown on a background of smoke from the burning building. He admitted that he did not know the history of the picture, but it looked so much like the famous Cenotaph spirit photograph that he adopted it. I recognized it at once as a fake made by a Chicago photographer to show Dr. Hodgson what could be done. I saved the lecturer



AN ECTOPLASMIC PHOTOGRAPH

This photograph, taken by the Falconer Brothers, was reproduced in the "International Psychic Gazette" for September, 1925



MURILLO'S "HOLY FAMILY"

The upper portion of this painting was used as the basis for the "spirit photograph" shown on the right

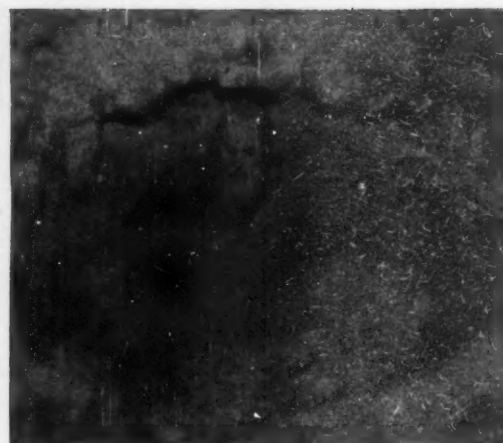
from repeating his blunder, and would not tell the story now had Doyle not become so bitter against common-sense caution, and so dangerous to the public which thinks the inventor of an impossible detective of fiction must himself be a good detective.

The *International Psychic Gazette* for September contains the reproduction of a photograph taken by two boy mediums, whose effects are peculiarly cotton-battened, in a spiritualist church in England. At the top is a male figure with long beard and one hand extended with fingers spread. Flanking this are several small nude child forms. The "ectoplasm" lies about thickly. The mother of the photographers, a medium, said that the adult figure was that of St. John the Evangelist, who at times is her guide. Sir Arthur Conan Doyle is quoted as saying that this is the most remarkable spirit photograph he has ever seen. And four mothers recognized their children in the four baby forms.

Do London spiritualists never visit their National Gallery? There hung, and I suppose hangs now, the original of that picture of "St. John" and the four recognized children, unmutated and unectoplasmated. Am I the first to discover the fact that the upper two-fifths of a print of Murillo's *Holy Family* is what furnished the basis of this "spirit photograph?" The "St. John" was meant by the artist for the Deity, the four recognized children are the cherubs common in such pictures two and a half centuries ago, the dove has been blotted out by "ectoplasm," and the lower half of the picture cut away. But I will not dispute that this is the best spirit photograph ever.

Familiar Chirography in "Psychographs"

"Psychographs" are supposed to be spirit writing appearing on photographic plates. William Hope gets a lot of it, and it is noticeable that some of his spirits adopt his quaint modes of spelling and certain mannerisms of his style. One of his spirits, probably to show his learning, introduced this specimen of Latin: "ob mort-es nostr-orum fratr-um dob-emus," and pretty effectually showed that he or his medium, in copying from a Latin grammar, did not know that the hyphens are simply to point off for beginners the case and tense endings. Other Latin phrases occur, but they are stock ones easily found in a printed table. Henslow printed a psychograph which came via Hooper, also containing stock Latin phrases, and witnessing to the fact that they



DOYLE'S "BEST SPIRIT PHOTOGRAPH"

Claimed by the spirit guides to be a picture of the Apostle John. The four cherubs were "recognized" by four mothers as their children

were cribbed from a table, since a half dozen are inserted in alphabetical order.

W. M. Keeler is the proud recipient of psychographs written by illustrious spirits, from Socrates down—in Keeler's chirography. Hope produces scripts which are undoubtedly in the genuine handwriting of dead men. But these have a curious mottled appearance, found only in the psychographs where the writing can be compared and found identical with that of definite men who have lived. The example here given, signed by W. J. Crawford and stating that he is present at a sitting after his death, was written, every word of it, by him, but not a single sentence. That is to say, words have been cut out of life letters by Crawford, and joined on a dark background to make sentences, with the edges clouded by paint or some other material. Another specimen in Doyle's book, signed W. Walker, is so ill-disguised that the actual straight edges of the clippings show through. These are either manifest frauds or the spirits went to great pains to prove them such.

I do not say that my psychograph, signed W. Hope, duplicates the effect of the Crawford one; it is a first attempt and not daubing enough. But if Hope had been dead when a photographic sitting was held in Birmingham on May 18, 1924, and this had been developed on the plate, how convincing it would have been! For every word was actually written by Hope.



TWO NOTED PERSONS

In a frame of cotton-battened ectoplasm. A "spirit" photograph made by an assistant of Dr. Prince to show how "spirit" photographs can be made

Our Point of View

Two Hundred and Fifty Miles an Hour

A MILE a minute, or sixty miles an hour, is the commonly accepted speed of an express train between stops; and as the landscape—trees, houses and hedge-rows—streams by you, you have a very definite sense of high speed. Multiply that by four, and you would still be moving at something less than the speed achieved by the army airplane in the recent 1925 Pulitzer cup competition. Nature helped to heighten the, we had almost said, majesty of the performance, when she spread out as a background for the racers, a lovely silver sunset sky upon which was woven a delicate necklace of cirrus clouds that may have been some 20,000 feet above the earth. It was only for a few seconds that the little plane was within view. The distant drone of her motors rose to a crescendo like a rich organ note, as the plane swept hurtling across the skies, looking for all the world like a huge torpedo bomb that might have been fired from a giant rifle. Before the involuntary gasp of wonder had died away, the little ship had become a mere speck in the distance as she passed out of view in the autumn haze.

How many of the spectators, as they left the field, realized that it was only seventeen years ago that Wilbur Wright, father of aviation, astonished the world by flying 56 miles at a speed of 36.74 miles per hour? From 36.74 miles an hour to 249.7 miles per hour is a far cry.

What of the future?

Europe's Progress in Aviation

THAT Europe believes in commercial aviation is proved by the irrefutable logic of statistics. France has recently consolidated over a dozen commercial lines into five heavily subsidized companies. She claims a punctuality of service of 98 percent, and she does this with the same degree of safety as the railroads. In 1920, her commercial planes made 2,386 trips, travelled 853,959 miles, and carried 1,771 passengers and 77,038 kilograms of freight. Four years later, the number of trips had risen to 11,536, the number of passengers carried was 16,729; and she transported 877,591 kilograms of freight. Germany has literally grid-ironed Europe with air lines; and the rate of growth is phenomenal. Her services made 7,135 trips in 1923, carried 10,572 passengers and 87,550 kilograms of freight; and the following year the number of trips have risen to 11,939, and 20,869 passengers and 137,560 kilograms of freight were carried. Great Britain reorganized her commercial aviation in April, 1924, consolidating existing companies into the Imperial Air Transport Company, Limited. During 1924, 800,000 miles were covered and 18,000 passengers and 300 tons of freight were carried. On the London-Paris line, with three services daily, there have been no fatalities on the British subsidized services. Outside of commercial aviation, the British Government is building at least two dirigibles of five million cubic feet capacity, which are stated to be capable of carrying 100 passengers, besides freight and mail. These are designed to operate between London and Karachi, India, touching at Constantinople, Turkey and Teheran, Persia.

Our Future Lies in Commercial Aviation

It becomes increasingly evident that, if we are to develop aviation on a large scale, it will have to be done, not by the Army and Navy, but by the com-

mercial interests of the country. This is no reflection upon the two services, whose experimental work, done either in their own shops or through contract with private concerns, has kept American aviation in the front rank as far as the quality of its pilots and machines is concerned. With Congress in the mood to cut appropriations, and with Mr. Madden claiming that the Army and Navy have little to show for what they get, it is evident that if aviation is to wait upon large appropriations or actual subsidies—well, it will have to wait forever.

Nor are subsidies necessary. There is a better way. Let Congress pass the aviation bill that has been based upon the investigations of Mr. Hoover's committee, which has been cooperating with the American Engineering Council in gathering data about aviation here and abroad. This bill is based upon the belief that the Government should do for aviation what it has done for seagoing commerce. In promoting the latter, the Federal Government has lighted the channels in our harbors; published charts; furnished weather forecasts; provided a bureau to inspect vessels for seaworthiness; provided for the examination and certification of maritime officers, and finally, has developed and improved ports and river and harbor channels.

A Man and a Sheep

Someone once asked: "How much, then, is a man worth more than a sheep?"

That was some thousands of years ago; but in view of the perfectly shocking day-by-day list of automobile fatalities, the same question may well be asked today. The record of people whose lives are blotted out or whose bodies are wrecked or permanently disfigured makes a gruesome story. But even more shocking, to our way of thinking, is the apparently callous indifference of the public and the public press which latter is, or is supposed to be, its mouthpiece. Carefully considered legislation may do much to help; but far more can be done by awakening the national conscience to the magnitude and inhumanity of this preventable slaughter.

Now if the Federal Government can do all this for the ships of the sea, why should it hesitate to do the same for the ships of the air? Nay, the need is even more imperative. Extinguish our lighthouses; burn our charts; shut down our weather forecasts; stop all ship inspection and examination of pilots and officers and allow any one who wishes to take any leaky old "hooker" to sea; and what would become of our waterborne commerce?

It would cease to be!

But our airborne commerce is in exactly this parlous state—at least so far as government help and supervision is concerned. It has not ceased to exist for the very good reason that it has never been born. The provisions of the bill call for lighting the airways; studying the "air channels"; providing charts and ample weather forecasts; the licensing of pilots and mechanics; the inspection of planes, et cetera. The various towns and cities should provide and maintain landing fields. They provide sea ports for ships of the sea—they should do the same for ships of the air.

Thus, and in no other way, rest assured, can the United States build up a merchant air service.

The country waits upon Congress.

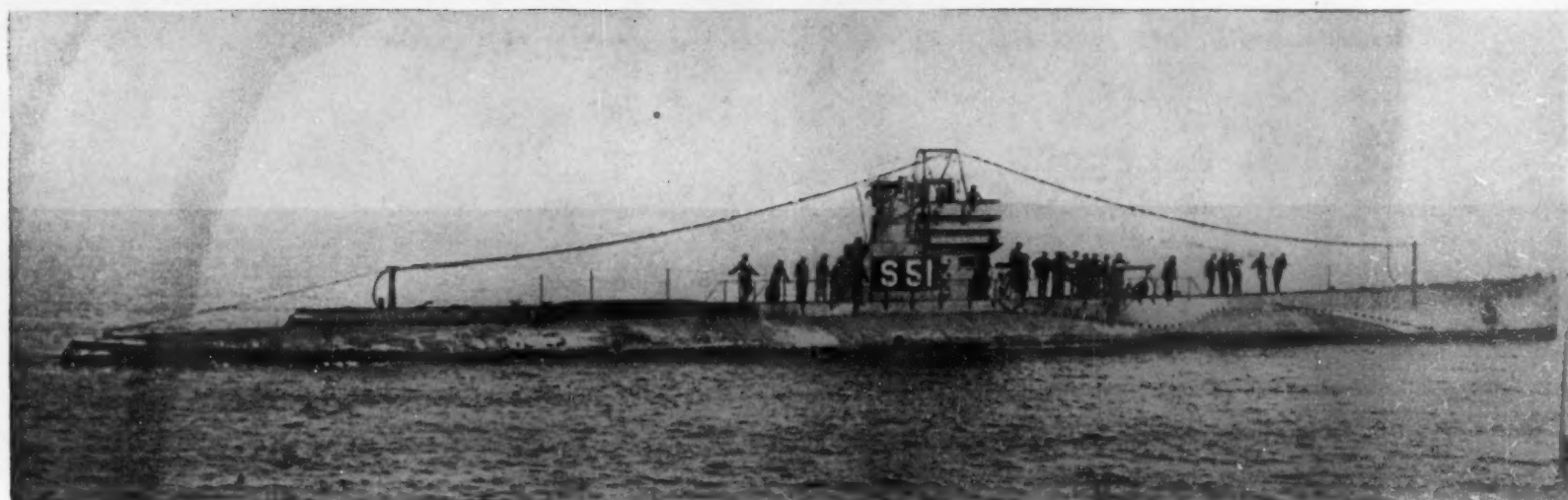
Why the Constitution Won

IN seeking after the causes which led to the victories of the *Constitution* in her famous duels with British frigates, we are carried back to the years before a stick of her timbers had been laid. In a letter dated January 6, 1793, Joshua Humphreys, her designer, wrote to Robert Morris describing the type of ship which the United States should build as the beginnings of its modest navy, and he said: "As our navy for a considerable time will be inferior in numbers, we are to consider what size ships would be most formidable and be an over-match for those of the enemy. . . . These ships should have scantlings equal to 74's (ships of the line). . . . Frigates built to carry 12- and 18-pounders will not answer." And Mr. Humphreys recommended 24-pounders as against the 18-pounders carried by frigates of that day. Speaking of his design, in another letter he writes: "They are superior to any European frigate, and if others (of the enemy) should be in company, our frigates can always lead ahead and never be obliged to go into action but on their own terms, except in a calm." The *Constitution* and her sisters were built as Humphreys suggested, and in his book, "The Frigate *Constitution*," Ira N. Hollis, a retired officer of our Navy, says: "With uncommon foresight, Mr. Humphreys made the hull frames, the planking and the masts of his ships fully equal in dimensions to those of a line-of-battle ship." Says Hollis: "The *Java*, for instance, fired 18-pound shot at the *Constitution*, whose sides were from 17 to 20 inches thick, while the latter fired 24-pound shot at the former, whose sides were from 11½ to 15 inches thick."

The far-sightedness of Humphreys gave to the young republic in the *Constitution* and her sisters an ideal vessel for the conditions that confronted them. The *Constitution* could not fight a line-of-battle ship; but if these came upon her, she was fleet enough to escape them. On the other hand, she was more powerful and swifter than the 18-pounder frigates of that day and could engage single ships with a fair certainty of success; and she could escape from a squadron, as she did off the Jersey coast, by virtue of good seamanship and fast sailing.

But powerful batteries, sweet lines in the hull and a vast spread of canvas would avail nothing without good men at the guns below and on the yards aloft and, above all, a commander with resourcefulness and initiative; and the *Constitution*, as her engagements showed, was strong in these human factors. The British, because of their proved superiority over the French when battles were fought at pistol range and ships carried by boarding, had grown careless in gunnery. Gun practice was practically unknown, whereas our gunners were exercised regularly with the clumsy weapons of that day. The *Guerriere* was of about the same size and power as the *Java*; and so good was the gunnery of the *Constitution* that every mast was shot out of the *Guerriere* and her hull was so frightfully riddled that she was in a sinking condition when she surrendered.

The American people should subscribe the \$500,000 necessary to save the *Constitution*, not only for her victories, but because she marked a new type of ship as notable in its way as was the *Monitor* of the Civil War.

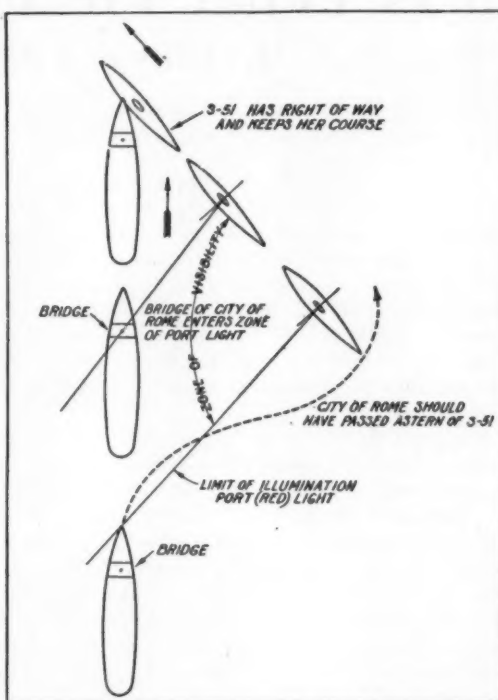


Tragic Loss of the Submarine S-51

Rammed by a Merchant Ship, the S-51 Sinks with a Loss of Thirty-five Men

DURING the night of September 25th, the submarine S-51, while engaged on her annual reliability run, was rammed by the steamship *City of Rome* and sank with a loss of 35 men within a minute or so of the collision. The S-51 was running on the surface and, it being night time, she was carrying a white light amidship and her riding lights—green to starboard and red to port. Judging from the statement of her three survivors and of the officers of the *City of Rome*, as printed in the daily press, it would seem as though the *City of Rome* overtook the S-51, coming up from behind on her port side, failed to understand the relative positions of the two ships, in which the S-51 had the right of way, and cut her down.

The S-51 is one of four boats of the "Lake" type. She is 240 feet long by 22 feet beam. She carried forward of the conning tower one 4-inch, 50-calibre gun. The accompanying longitudinal and midship sections show the subdivision of the ship. Essentially, she consisted of a strong, internal, pressure hull and a much lighter external hull, approximately concentric to it. She carried four torpedo tubes at the forward end of the torpedo room, which was provided with an escape hatch. Aft of this was the battery room and quarters where the crew were berthed. This also was provided with an escape hatch. Aft of this was the control room in which were located the diving and steering rudders and the various controls. Above the control room was the conning tower. Aft of the control room came the engine room and the motor room, each with its own escape hatch; and at the rear end of the motor room was the fifth torpedo tube. These compartments were subdivided by watertight bulkheads, each



S-51 HAD RIGHT OF WAY
Portable courses of S-51 and City of Rome

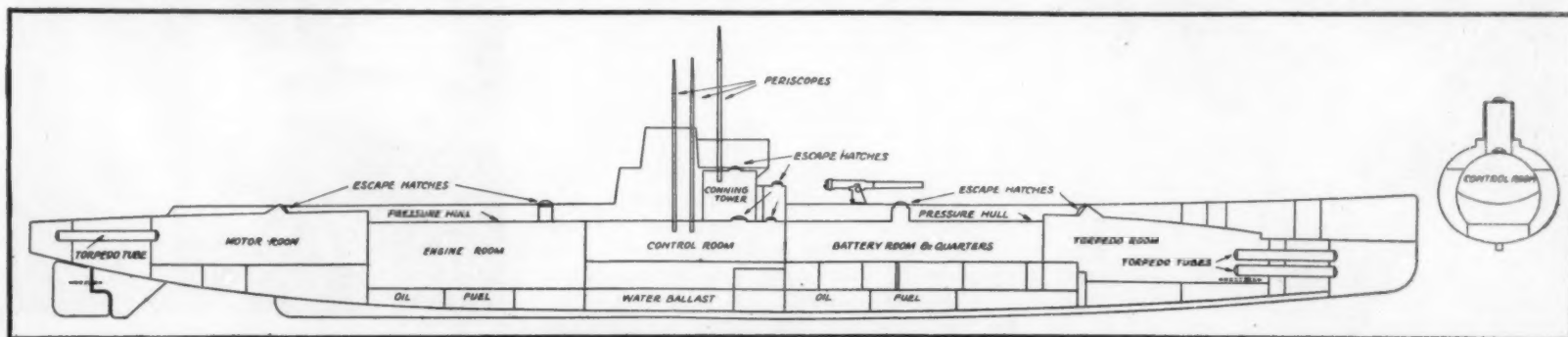
with a watertight door placed about a foot above the floor. The space below the various compartments was given up to oil fuel and water ballast; and oil fuel was also carried between the two.

Until the Board of Inquiry has delivered its re-

port, it will not be known just how this terrible fatality occurred; but both the captain of the *City of Rome* and the survivors have talked rather freely to the press; and from their statements, it is probable that the sequence of events occurred as shown in our diagram.

Apparently, the *City of Rome* and the S-51 drew together on converging courses, the *City of Rome* overtaking the submarine and closing upon her port side. The rules of the road demand that under such conditions, the ship to starboard, having the right of way, must keep on her course. This the S-51 did; for the divers found that her rudder, as she lay on the bottom, was amidships. If this be true, the *City of Rome* should have swung over to starboard, passed astern of the S-51 and then proceeded on her course. The *City of Rome* admits seeing the white masthead light of the S-51; but since the sidelights are hooded to ships astern, it was not until the *City of Rome* was within about 20 degrees of abeam of the S-51 that she was able to see her port red light. This was the time when the captain says she "flashed on" her side lights, and the port light first became visible when the *City of Rome* reached the second position shown in our sketch. She was now too close to avoid disaster; and in spite of reversed engines and the use of the helm, she cut deeply into the battery room abreast of the four-inch gun.

It is our belief that many hundreds of lives could be saved if the ramming ship would only keep her engines just turning over, or sufficiently to maintain her bow in the gash she has made. It seems to be a tradition of the sea to do just the opposite. When the *City of Rome* backed away, the water rushed in so fast that the crew did not close the watertight doors but made for the control room ladder.



THE INTERNAL CONSTRUCTION OF S-51
Longitudinal and cross-sections of the ship, published by courtesy of the Secretary of the Navy



Japan Press Illustration Co.

ON A JAPANESE RICE PLANTATION

In regions where the population has become dense, the land is too valuable for the grazing of stock, which would provide proteids. Hence the poor often go protein hungry



Brown Brothers

ESKIMOS IN SUMMER CAMP

The Eskimo is forced to live on fats, for he lacks vegetables. But a fatty diet is deficient in proteids. The Eskimo is nearly always proteid hungry. His food fails to satisfy him

Man Is What He Eats

How Food Affects Physiology, Mentality and the Destiny of Races

By Rudolph M. Binder

Professor of Sociology, New York University

IT was about 1850 that Jakob Moleschott expressed his materialistic philosophy in one terse sentence: "Man is what he eats." On account of this indiscretion of speech, he lost the chair of physiology, anatomy and anthropology at the University of Heidelberg.

In our day, however, this very doctrine is taught, not only in universities and colleges, but in high schools and occasionally even in the upper grades of the grammar schools; and the remarkable fact about it is that the moral chaos predicted by the theologians who ousted Moleschott has not arrived. We are perhaps more moral and spiritual than our grandfathers.

Owing to our better knowledge of food values,

acquired since dietitians, chemists and physiologists have studied the problem jointly, the present generation has, undoubtedly, been fed better, both as respects quantity and quality. Of endemic diseases, such as hookworm and malaria, the International Health Board of the Rockefeller Foundation has furnished ample proofs, both in our own southern states and in other countries, that weight and stature increase after the elimination of one or both of these diseases.

For good quality of the population of a nation, a certain kind of mentality is required. Mere well-groomed human animals may be pleasant to look at. They get rather tiresome, however, after a while, when they manifest no "spark divine" in action or in conversation. Among the mental qualities, we require a fair amount of intelligence, and the ability of a population to produce men of high capacity, at least occasionally. A race which fails to produce leaders suitable for its civilization will never rise to a higher level of civilization.

Food Affects Mental Qualities

Morality is another mental quality. By this term we mean, not so much the conformity to an established code of ethics, as perseverance in striving for a goal, the ability to act independently and, what we call for lack of a better term, spirituality, that is, a certain aspect of mind which looks beyond the immediate and the expedient to the ultimate and the fundamental.

Sociality is the third mental quality desired. This term is, of course, not used here in the sense of being a "hail fellow, well met," but in the sense of the ability to cooperate with others for the welfare of all.

These three mental qualities—high capacity, spirituality, and sociality—there are others but those mentioned are fundamental—when combined with health and stature, form the basis of good quality in a population. Our concern is now to indicate how food affects these qualities.

Recently Ellsworth Huntington published his "Civilization and Climate," and the writer his "Health and Social Progress." Huntington tried to

analyze climatic influences into special factors—humidity, optimum of temperature, also seasonal and daily variation of temperature. His theory of cycles of climates is supposed to account for the rise and fall of civilizations.

The present writer, however, lays stress chiefly on the presence or absence of health as determined by endemic diseases and proper food. He emphasizes the fact that in cold climates, food consists primarily of meat and fat, while in the tropics it consists principally of various plants, and that each is inadequate, owing to its one-sidedness. He explains that many of the migrations of peoples, especially those that took place from north to south, were based on the search for a mixed diet, and that civilizations had sprung up where such a diet could be had in



From the nation picture, "Glimpse"

MOUNTAIN PEOPLES ARE USUALLY VIRILE
Spring and fall, a Persian tribe must cross a lofty mountain range in quest of pasture. Only the virile survive



Kerstone View Co.

TROPICAL DIET IS CHIEFLY VEGETARIAN

Tropical foods are as deficient in proteins as those of the arctic regions, and there is the same protein hunger

countries comparatively immune from endemic diseases. Owing to the advances made in physiology and the chemistry of foods, lately, increasing stress has been placed upon a properly mixed diet.

A scientifically mixed diet could scarcely be obtained in the past, except in the sub-tropics and in the southern regions of the temperate zones. The only way the deficiency could be met was by migrations, chiefly from the north to the south, but never to the tropics. Hence arose the series of local and temporary civilizations in Egypt, Palestine, Mesopotamia, and so on, and they resulted from the contact of two peoples and the better feeding of the northerners. Afterwards, the effects of endemic diseases began to be felt, and the civilizations gradually deteriorated.

Proteids and Stature

Let us now look at the absolute necessity of a varied diet for the building up of a good physique and sound health. In the northern part of the temperate zone, people have to depend chiefly on an animal diet. Since the meat they eat is derived chiefly from game which is lean, their food is principally proteid and they are of fairly high stature or of stocky build. The game contains a certain amount of fat, and if this is supplemented by milk or some vegetable matter, the diet is fairly well balanced. Hence, the Norsemen and other peoples under similar geographical conditions were, as a rule, tall, well-built and energetic.

Going farther north, into the frigid regions, we find a predominance of fat. The Eskimos revel in fat, and drink and eat large quantities of it. They need it for fuel, so as to keep their body temperature around ninety-eight degrees, Fahrenheit. Sometimes, however, the whaling is poor, and the Eskimos have to live for long periods on fish which is largely proteid instead of fat. They eat and eat; but still they remain hungry, because their bodies clamor for carbohydrates.

An active, adult, human male needs, among other things, about four and a half ounces of proteids and eighteen ounces of carbohydrates (including fat) per day. The Eskimo has to live sometimes for weeks on fresh cod. In order to supply the four and a half ounces of proteids he needs two and a half pounds of fresh fish; that is, of course, not too much and any person can do it. But, to supply the eighteen ounces of carbohydrates and fats, he would have to eat 564 pounds of cod, because codfish are very lean and contain only traces of carbohydrates. He is unable, of course, to eat that quantity, and so he



University Photographic Laboratory

TEMPERATE-ZONE DIET IS BEST BALANCED

Wherever food containing all the needed elements is available without too fierce a struggle, man is at his best

eats and eats but still his hunger is unsatisfied.

And there lies the tragedy of the arctics. The large quantities of food derange the intestines, and disease and death soon follow. There are, of course, no cereals, fruits or vegetables to correct this one-sided diet, and the result is: little endurance and stamina and a short life.

In the tropical region diet is just as one-sided, but in the opposite direction, as in the arctic. This time it is owing to an almost exclusively vegetarian diet. In the rain-forests the people depend almost entirely on bananas or similar fruits. They get plenty of carbohydrates, but little protein; hence they, too, eat and eat like the Eskimos, but without being satisfied, since it would take from seventy to eighty bananas per day to provide sufficient protein. The great bulk of food thus required produces potbellies and big paunches, misshapen features and stunted bodies.

In the tropical jungle the diet is only slightly better. Sweet potatoes and yams are raised, coconuts and bananas are collected. This diet gives somewhat more of a variety but still very little protein. People may eat ravenously, without being

satisfied. A little meat may be secured occasionally by killing a fowl, squirrel or by catching fish, but not enough to offset the damage done by the lack of protein.

Where, as in the monsoon regions, millet, rice and corn are raised, the diet is improved considerably; but these grains contain twice as much starch as is advisable. Where, as in China, the population is in many parts very dense, little land can be spared for raising cattle, pigs, or even chickens, and the demand for proteids is not met by the cereals. Hence, many poor people have to resort to the eating of rats, dogs and other low mammals for satisfying their need for protein.

Fish-raising is extensively engaged in for the same reason, since it does not require the use of land. To supplement the need for protein still further, the Chinese raise legumes extensively, especially beans, which are rich in protein. Carbohydrates are still too prevalent, though, in this diet; it lacks, moreover, the acids and minerals of fruits which the Chinese consider a luxury.

Civilization and Mixed Diets

In the sub-tropics, wheat, one of the best all-round foods makes its appearance; these regions have likewise an abundance of fruits, and are favorable for the raising of domestic animals, especially sheep and goats. The diet is, consequently, well balanced, and this is the reason why most civilizations have originated there.

In the cyclonic regions, as Professor Huntington calls the temperate zones, there is a great variety of good food; it is constantly available, it is usually well-cooked and is served regularly. This is one reason why permanent and widely extended civilizations have arisen there; the other reason is the comparative absence of endemic diseases.

Food is not the only cause of the rise of civilization, as has already been intimated. Other causes are the absence of endemic diseases, variety and multiplicity of contacts, easy communication and transportation, the form of government, type of religion and so on. The only thing that needs emphasis is the necessity of surplus energy which is a product of proper food and the comparative absence of disease.

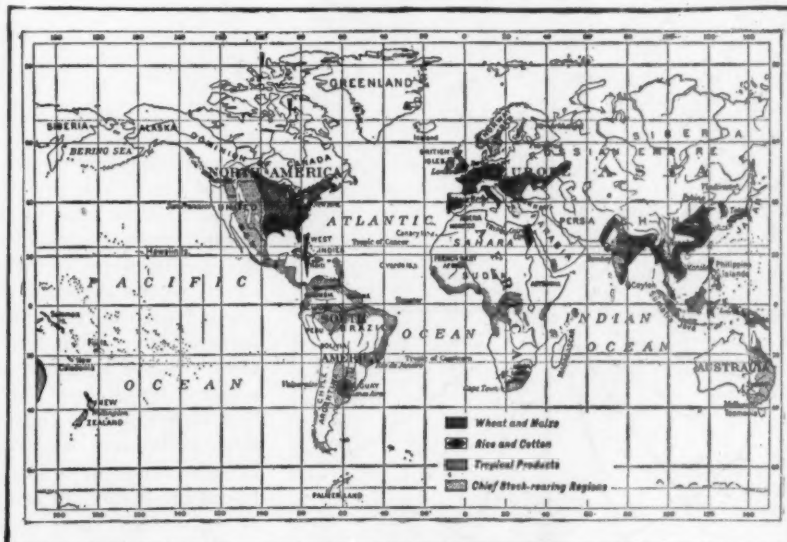
Surplus energy can be created only by a variety of food and at least some leisure. This is the reason why most of the innovations in society have come from the comparatively well-to-do leisure classes who had at least a fair variety of food, some surplus energy, and time for letting their imagination roam.



Drawn by Arthur T. Merrick

DOES MAN'S FOOD GOVERN HIS PHYSIQUE?

The food of the temperate zones best favors man's growth. The arctics and the tropics furnish diets deficient in the essentials for man's finest development



A MIXED DIET FOSTERS CIVILIZATION

Great migrations of peoples, particularly those from north to south, have at their root the unconscious search for the kind of mixed diet that enables man to thrive best

The "Constitution" Saved by Canvas Sea Anchors

Story by an Eyewitness on Board the "Constitution"

By William H. Woodwell

THE author of this extremely interesting contribution to the history of the *Constitution* tells us that Gideon Woodwell, a shipbuilder of Woodbury, Massachusetts, was ship's carpenter on the *Constitution* in 1812. "He died in 1840, and my family notes have the story, as related by him. I have followed the language of the original notes quite literally, as they have the nautical tang."

EDITOR.

The efforts now being made to preserve our most famous ship—the *Constitution*, have drawn wide attention to her glorious history. One of the exploits frequently referred to is that vessel's escape from a British squadron in 1812. Credit is given to her sailing qualities, and the skill of her commander, in drawing away from a superior force, but these were not the only factors.

The exact means by which this sensational escape was accomplished are not generally known, but furnish a striking example of Yankee ingenuity and resourcefulness.

The Escape

The stirring story as told by Cooper, in his *Naval History*, was published during the lifetime of survivors of 1812. This quotation is drawn from his *History*:

"The *Constitution*, under command of Capt. Hull, sailed from Annapolis on the 12th of July, and stood to the northward. She had a new crew and being provisioned for a long cruise was deep in the water. On the 17th she sighted a man-of-war, which subsequently proved to be the *Guerriere*. Four other sail were also sighted, and all five appeared to be in company. The afternoon and night passed without incident, but in the morning Capt. Hull discovered two frigates on the lee quarter, and astern were a ship of the line, two frigates, a brig and a schooner.

"It was now quite calm, and the *Constitution* hoisted out her boats and sent them ahead to tow. By six o'clock a light wind came from the northward of west; the ship's head was got round to the southward, and all the light canvas that would draw was set. Soon afterward Capt. Hull, finding that the enemy was likely to close,



THE FAMOUS SHIP

The *Constitution* doing 12 knots in a strong breeze

as he was able to pull the boats of two ships on one, ordered all the spare rigging which was fit for the purpose to be payed down into the cutters. Then a kedge was run out nearly half a mile ahead and let go. At a signal given, the crew clapped on, and walked away with the ship, overrunning and tripping the kedge as she came up with the end of the line. While this was doing, fresh lines and another kedge were carried ahead, and although out of sight of land, the frigate glided away from her pursuers before they discovered how it was done."

The "kedges" here referred to were of a peculiar construction; in reality they were huge umbrellas, and the following details were related many years ago by one of the ship's crew, who took part in the adventure.

A number of white oak sticks of timber, from twelve to sixteen feet long and from six to eight inches square, were in the lower hold of the *Constitution*. The boatswain was ordered to have them on deck, the carpenters went to work; four of the sticks were reduced to three and a half inches at one end and five at the other. In the upper or small end of the stick a hole was put through to receive a line, and the same in the butt, or large end; the sail-makers, with some of the men who could handle the needle, were set to work, and a covering of canvas in the shape of an umbrella was soon finished, from twelve to thirteen feet long, and from twenty to twenty-four feet across. Some small spars were reduced to about three inches and cut the required length, and four of these sticks were put into each canvas. The upper or forward ends of these sticks were held together by a lanyard, and the after ends were stopped to the canvas with a lanyard rope through and made fast at the butt ends of the sticks. These sticks were made fast to the canvas only at the outer end. In warping the ship the canvas would have a half sweep or circle, while the stick would remain straight.

When Capt. Hull saw all the boats sent to help

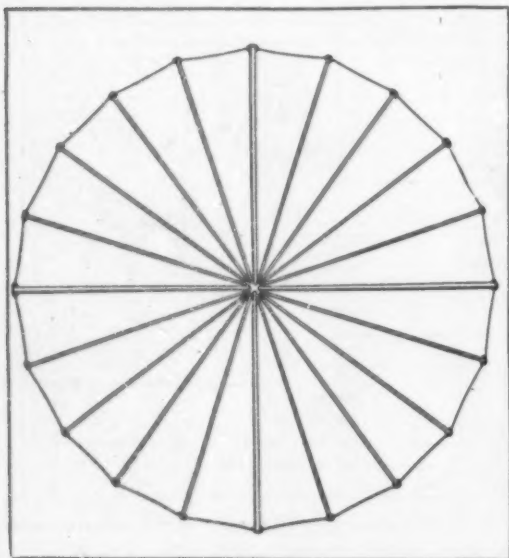
the *Shannon* (the nearest English frigate), four boats dropped from the *Constitution*, and pulling under her bows, from eight to ten fathoms of line were paid down to each boat, one end made fast to a ring bolt in the stern of the boat, the other end fast to the forward end of the umbrella. The umbrella was dropped into the water with a line fast at the butt, or after end. Then came the word, "Give way, boys." In pulling from the ship the umbrella would shut up, and in pulling on board the umbrella would open.

The lines fast to the umbrella were from eighty to one hundred fathoms in length. By this arrangement but one boat was pulling from the ship at a time, and in warping the ship each boat's crew would lie on their oars, and were always ready to give way when the word was given. By this means the crew warped the ship through the water several knots an hour. Had it continued calm even the whole English fleet could not have captured the *Constitution*.

British Are Wary

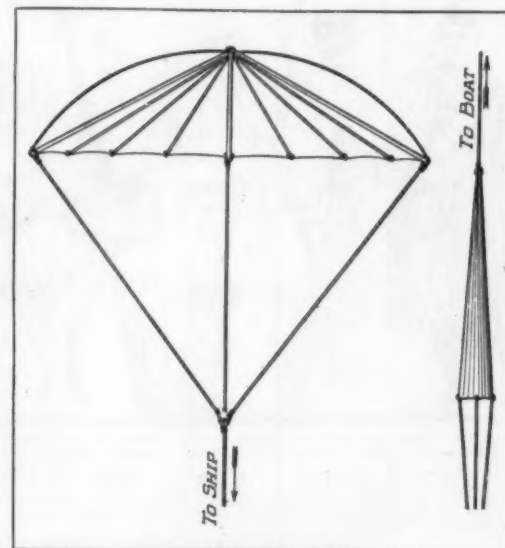
With all the boats the *Shannon* had they could not make as much headway as the *Constitution*. For two reasons the officers of the *Shannon* did not want to get within good gunshot of the *Constitution* while the other ships were so far off. One reason was, they were satisfied the *Constitution*, with her after guns, would destroy the attacking boats and at least part of each crew, and the second was, they did not care to engage the vessel alone, knowing that, in the *Constitution*, they had a formidable antagonist to contend with.

After seventy hours of very little variation in the weather, a light, southerly breeze sprang up, which brought the *Constitution* to windward. The boats were dropped alongside, tackles hooked on, and lifted out of the water, the yards were braced to the wind, sheets hauled aft, tacks hove down, ship on the wind, with the port tacks aboard, and working to windward like a thing of life, decks cleared up, boats hoisted in, the gripes put on and made fast; the whole ship's crew as merry as a hive of bees, and looking back on the past seventy hours more like a pleasure excursion than one of arduous labor and danger.



PLAN VIEW

The clever device that saved the *Constitution*

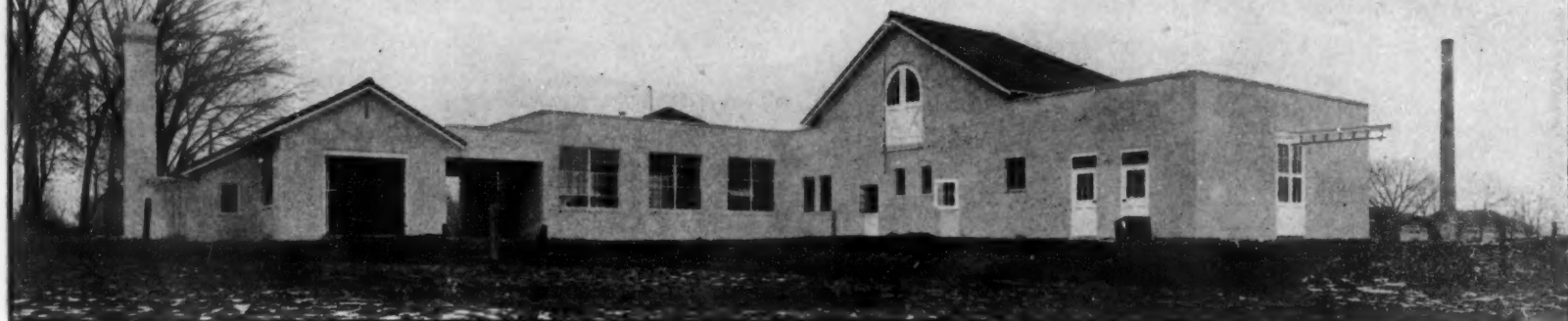


SECTIONAL VIEW

The sea anchor open and closed

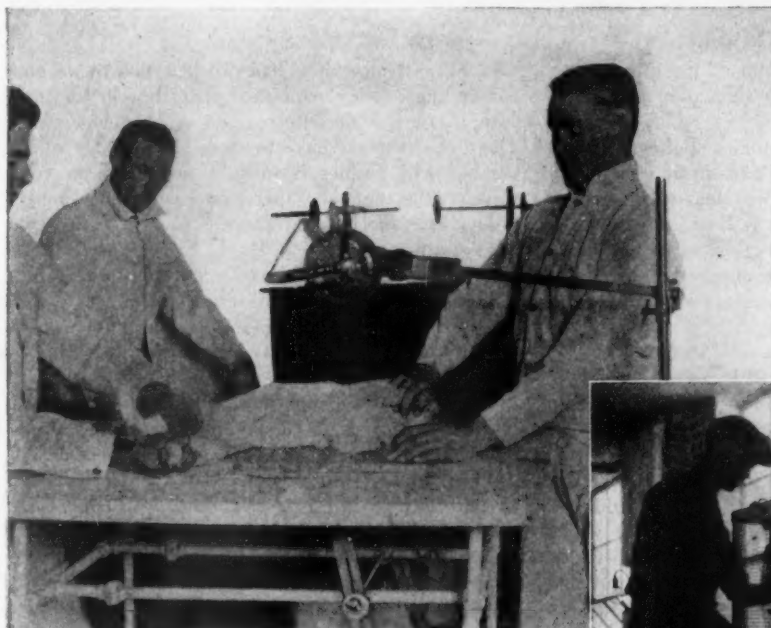
Veterinary Department of Western University

Finest Anatomical Laboratory of Its Kind in America



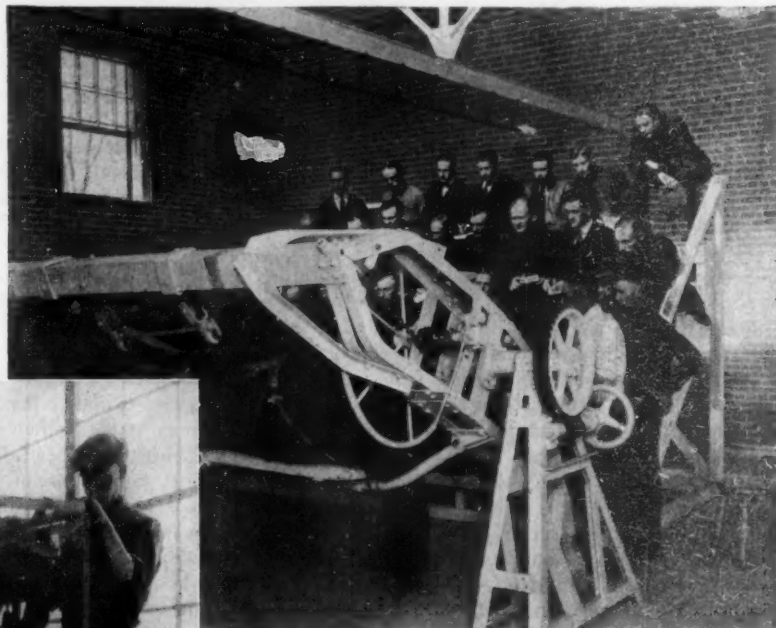
SOME OF THE BUILDINGS OF THE COLORADO AGRICULTURAL COLLEGE

In this hospital and anatomical laboratory students of the college study the treatment of animals at first hand; and the animals, incidentally, receive the best of care



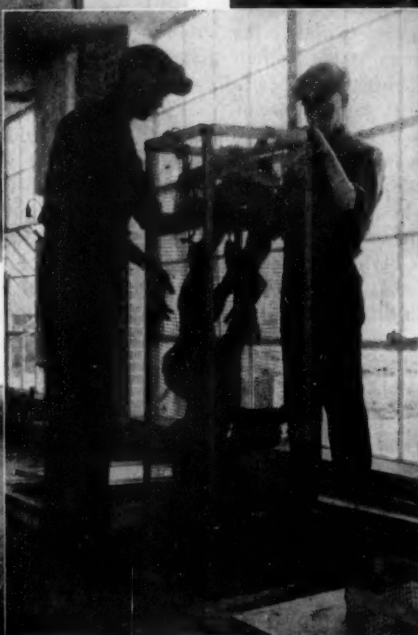
AN APPARATUS WHICH SERVES BEAST AS WELL AS MAN

In the laboratory this apparatus for taking X-ray pictures of animals is used extensively by the students studying animals and their diseases



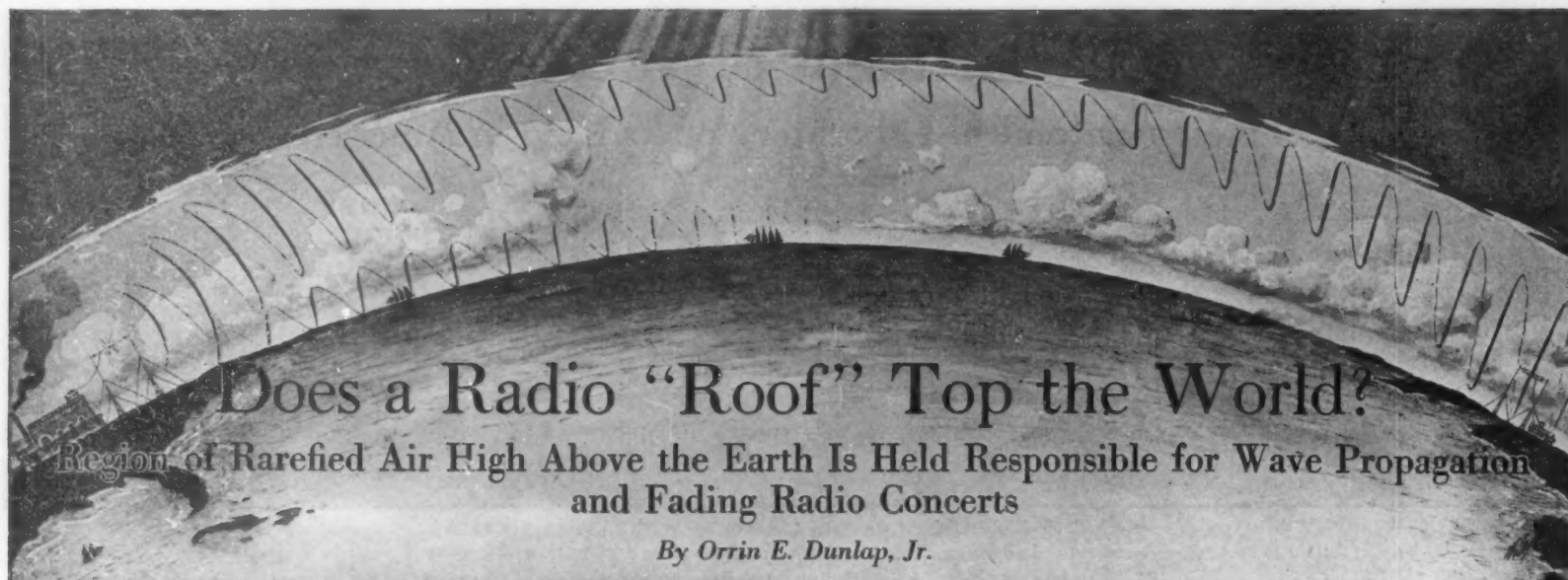
A CLOSE-UP VIEW OF AN IMPORTANT OPERATION

From a movable section of seats the students watch operations. The special revolving operating table is big enough to accommodate large animals



ALL THE COMFORTS AND CLEANLINESS OF A HOSPITAL FOR HUMANS

LEFT: The stables in the Veterinary Hospital are a model of cleanliness. INSERT: The specimens in these racks are used for classroom studies and are lowered into vats of preservatives when not in use. RIGHT: A corner in the dog ward. The individual cages have concrete floors and are easily cleaned



Does a Radio "Roof" Top the World?

Region of Rarefied Air High Above the Earth Is Held Responsible for Wave Propagation and Fading Radio Concerts

By Orrin E. Dunlap, Jr.

A PECULIAR green line has been found in the upper levels of the atmosphere which seems to give an indication of the track that radio waves follow in their flight through space. Professor J. C. McLennan, of Toronto University, in observations he made of the aurora borealis found that the green-line spectra apparently originate in highly rarefied oxygen, and that the intensity of the emerald hue is increased considerably by the addition of helium. He told the British Association for the Advancement of Science, that his experiments revealed that the aurora light comes from a region at least 60 to 100 miles above the earth and that at that height the air contains twenty to thirty times as much helium as oxygen.

It is this ionized region which is blamed for causing radio concerts to fade, giving far-away stations great volume for several minutes, then swinging them into silence, as if some strange force were purposely fluctuating the intensity in order to tease radio fans, with ears strained, to catch the call letters carried by the elusive waves.

The existence of a conducting surface due to ionization was postulated by Professor Schuster of England in 1887. This was before Marconi started his experiments. Sir Oliver Heaviside, an Englishman, and Professor Kennelly of Harvard, in 1900, suggested that an ionized region in the upper levels of the atmosphere might have an effect in wireless

wave propagation. This section of the atmosphere, therefore, has been referred to since that time as the "Heaviside surface."

The Naval Research Laboratory at Bellevue, D. C., cooperating with the Carnegie Institution of Washington, recently confirmed the Heaviside-Kennelly theory. Secretary of the Navy Wilbur, in making the announcement, spoke of the region as "a ceiling in the sky, at a varying distance above the surface of the earth, rising and falling as atmospheric conditions vary."

Why There Are "Dead Spots" in the Ether

Experts explain that there are undoubtedly numerous strata rather than a single surface or "roof" in the upper altitudes and that differing electrical conditions of the ionized region affect various wavelengths differently. Reginald A. Fessenden, in 1906, estimated the height at which marked absorption takes place to be roughly 300 miles at night and 100 miles in the day, and that the surface is not smooth but is broken up into clouds of ionized air.

Larmor, an English physicist, has shown that the altitude of the conducting level varies for different wavelengths, and it is thought that this presents an explanation of the differing character and distance covered by short waves and at different hours.

H. W. Nichols and J. C. Schelleng, of the Bell Telephone Laboratories, New York, in March, 1925,

told of a theory they had worked out to account for fading. They explained that the earth's magnetic field has an effect upon wave propagation. Their observations have furthered knowledge of the reasons why fading is more pronounced on some wavelengths than on others, and why the plane of polarization of Hertzian waves is rotated as the wave advances through space. Dr. E. F. W. Alexanderson has experimentally demonstrated this change of polarization; and the "corkscrewing" of waves high into the upper air, instead of sending them horizontally, may do a great deal to minimize fading and to overcome "dead spots" in the ether.

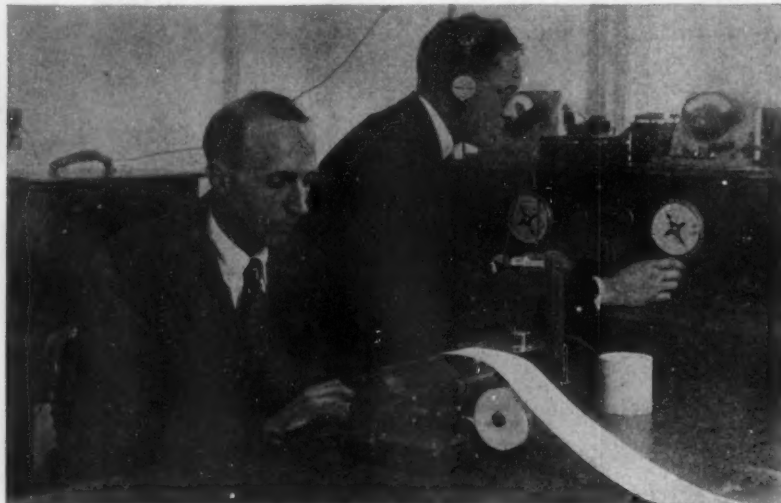
In 1920 the Bureau of Standards pictured what happens to waves in the high levels of the atmosphere by comparing radio wave transmission with the German long-range gun which bombarded Paris at a distance of 75 miles. Dr. R. H. Dellinger, Chief of the Radio Laboratory of the Bureau, has pointed out that the rarefied higher portions of the atmosphere, which permitted the projectile to fly toward Paris with little resistance, played the same role that the upper electric strata of the air play in broadcasting, because certain conditions of ionization allow radio waves of particular frequencies to travel enormous distances around the globe. Just as the Germans aimed the gun at a very high elevation in order to put the projectile quickly up into the little-resisting portions of the air, so nowadays radio engineers are working on the principle of shooting



© Harris and Ewing—Wide World

EXPERT KEEPS AN EYE ON FADING SIGNALS

Dr. J. H. Dellinger, Chief of the Radio Laboratory of the Bureau of Standards, is a student of swinging radio concerts, along with the many other phenomena of the ether which puzzle engineers. He believes the sky's conducting region is an irregular surface, not a definite layer



Wide World

MAKING A RECORD OF SWINGING ETHER WAVES

Impulses from a broadcasting station are detected and amplified by a super-heterodyne and passed through meters which aid in making a pen-and-ink sketch of how the waves vary in strength. These operators are watching the effect of the sun's eclipse on WGY's signals

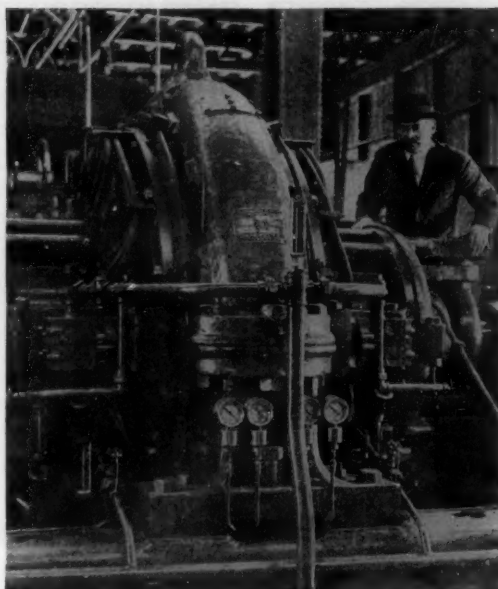
radio waves upward instead of radiating them horizontally from the aerial.

Fading is chiefly noticeable when the broadcasting station is more than 100 miles away and it usually becomes more marked as the mileage between the transmitter and receiving antenna is increased. The effect is more apparent on short wavelengths, that is, under 600 meters.

Dr. Alfred N. Goldsmith has pictured the Heavside surface as a mirror or copper sheet suspended in the sky and, owing to natural causes, the reflecting power of this conductive sheet varies from time to time in the same way that a mirror reflects well at one minute and then becomes dim when a person breathes upon it. A mist or layer of air forming over the surface of the ether's great mirror seems to mar its reflecting properties and thus the signals wax and wane. Supporters of this theory contend that during the day the powers of reflection from the Heavside surface are considerably impaired by the sun's rays; therefore, daylight reception is by means of waves that travel along the earth's surface instead of by way of the Heavside surface. This, together with the fact that the sun's rays absorb much of the energy from radio waves, is given as a reason why far distant broadcasting stations are inaudible during daylight.

Ground Waves Die Out Quickly

There is apparently little doubt that radio waves travel over two main routes. Secretary Wilbur in telling about the Navy's experiment pointed out that the opinion of radio experts relative to the existence of two distinct wave routes was found to be true. One of these waves, known as the "horizontal wave," travels close to the ground and the other "vertical wave" arrives by way of the "ceiling" or ionized region. There is a theory that fading of distant stations is also caused by an interaction between the ground and sky wave of a station when they meet at a certain point. However, there are some who differ with this theory. They say that the ground wave of a distant transmitter is too weak



Courtesy of General Electric Company

HE IS ATTACKING THE FADING PROBLEM

Dr. F. W. Alexanderson, inventor of the Alexanderson high-frequency alternator, is now experimenting with a new system of transmission. He corkscrews the waves high into the upper atmosphere instead of sending them out horizontally as at present, and the new method is looked upon as a means of overcoming fading.

to have any influence in interaction with the more powerful sky wave.

Concerts picked up during the daytime are generally from stations within a fifty-mile radius and they are thought to travel close to the ground, as a bee would crawl around a baseball. These ground waves die out quickly because they are absorbed by objects such as trees, steel structures, and electric wires. For example, auditors in the upper section of Manhattan Island report difficulty in hearing some of the less powerful transmitters in the downtown district. This is chiefly because reception is by means of ground waves. Listeners two hundred

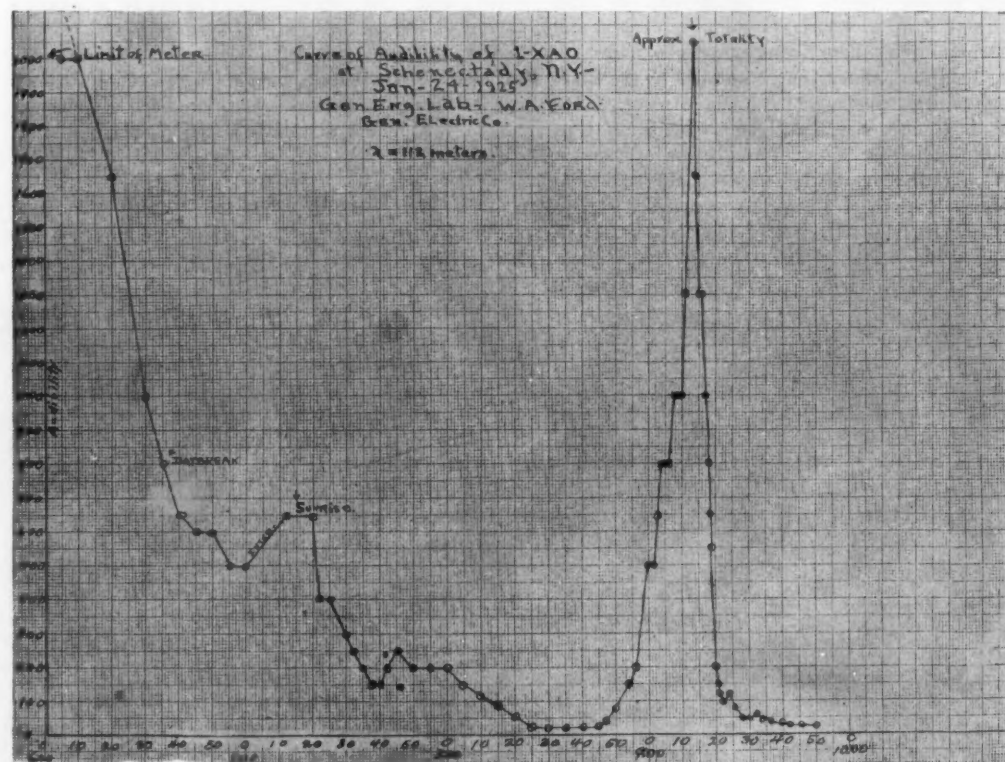
miles or more from a lower Broadway station get the waves traveling along the ionized region and not after the impulses have passed through several miles of energy-absorbing steel skyscrapers.

Night reception of stations outside of a 100-mile radius is generally by means of the sky waves and, because there are no absorbing objects along the mirror surface such as exist on the earth, the concerts travel much further. The absence of sunlight is another factor which increases the night-reception range.

Dawn has a greater effect upon radio waves than any other period of the day, because of the rapidly changing conditions of the atmosphere. Everything seems to "go dead" for about an hour at daybreak. Signals swing and fade more at that time than at any other time of day or night. Just as a person stops reading for an instant when they turn a page in a book, so it seems to wireless operators that Nature turns a page in the book of time, each day at sunrise. It is estimated that the sun's rays decrease the strength of radio signals about seventy percent.

Keep Antennas Far Apart

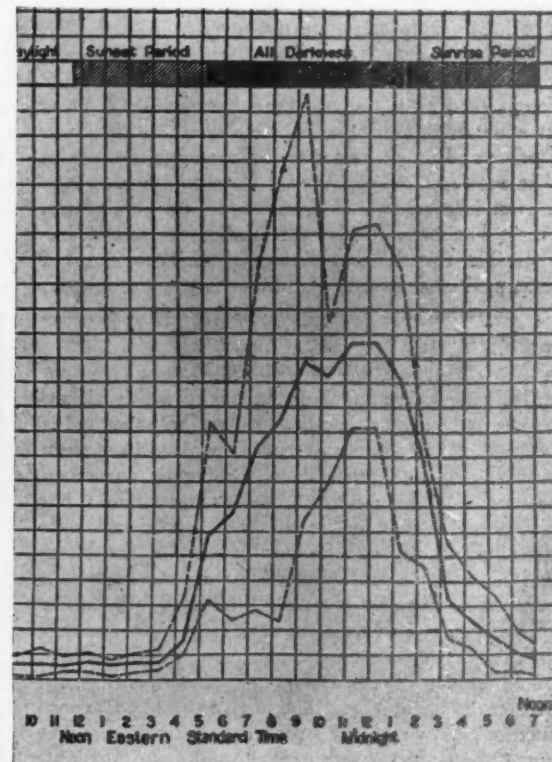
The broadcasts of local stations are not bothered by the rarefied region. If the waves of a nearby transmitter fade, Nature is not to blame, but the owner of the set will find some defect at the receiving end, such as a loose connection, a swinging antenna, worn out batteries, with their current fluctuating, or a defective vacuum tube. If one antenna is too close to another, and especially if the wires are parallel, the signals of local stations are likely to swing and at times disappear. When the owner of one antenna tunes his set he changes the capacity of the antenna system and that affects the nearby antenna. When either set is tuned it throws the other out of tune. This is often observed in New York and other large cities, where the antennas on apartments are so close together. The best remedy is to run the wires at right angles to each other and keep them as far apart as possible.



Courtesy of General Electric Company

AUDIBILITY CURVE OF 112-METER WAVES DURING SUN'S ECLIPSE

As dawn approached, the strength of the signals grew weak rapidly. The audibility was low at 7:00 A. M., ten minutes before sunrise, then the signals grew louder and became steady for five minutes, only to grow weaker and weaker until 8:40, when the largest portion of the sun was shadowed. Then, as the darkness approached, the waves showed renewed strength just as they do at night. After the period of totality, the waves faded and could scarcely be heard, as is generally the case with 112 meters during the daylight hours.



WAXING AND WANING OF RADIO WAVES

This chart shows how long-wave signals broadcast from Rocky Point, Long Island, vary in intensity as they are received in England. The heavy line is the average for 54 days. Note the field is relatively steady and free of fading at night. The dotted lines show maximum and minimum strength.



United Newspictures

THE HEALING VIRTUES OF SUNLIGHT

Dr. Alfred F. Hess demonstrated that the sun's rays have the strongest bacteria-killing effect during the midday hours. Dusty air stops these valuable rays, however



General Photographic Agency

ARTIFICIAL SUNLIGHT FORESTALLS RICKETS

Dr. Harry Steenbock demonstrated an indirect effect of ultra-violet light on bone building. Window glass or electric light bulbs stop ultra-violet rays

The Progress of Medical Science—III

Deficiency Diseases and Cancer; Methods of Diagnosis; Drug Therapy

By Morris Fishbein, M.D.

Editor, Journal of the American Medical Association, and of Hygeia

STRANGELY unusual are the facts regarding the so-called deficiency diseases, including scurvy, beriberi, polyneuritis and deficiency of growth. Here, the difficulty lies in the failure to supply the body with certain substances known as vitamins, which have been shown to exist in foods. Here again the actual composition of the vitamins is not known, but the effects of their absence may be scientifically demonstrated in a manner that is easily visible or comprehensible by anyone.

Certain diseases of the eye seem to be definitely related to the absence of such vitamins from the food, and animals whose food lacks vitamins grow at a much slower rate, and are likely to be much weaker and much less able to propagate the species than are those properly fed. These discoveries have a most important bearing on the feeding of infants, for it has been shown that rickets—a disease responsible for the production of vast numbers of deformed and weakly children—is caused in part by the absence from the diet of necessary vitamin substances.

Bottled Sunlight

The exposition of the manner in which rickets occurs and the way in which it may be prevented is typical of the complex processes involved in modern scientific studies. In rickets, the factors concerned are not only the absence of the proper vitamin, but also a deficiency in the diet of the mineral salts necessary to the proper development of the bones and of sufficient sunlight, which seems to exercise a stimulative function, causing the body to utilize properly the materials taken in for body-building purposes. Almost miraculous are the discoveries of Steenbock of the University of Wisconsin, and of Hess of New York, that it is possible to expose such substances as cod liver oil to ultra-violet light and to cause these substances to store up the light, carrying its effects in the tablespoon to the child who is given a dose of the medicine for rickets. Here virtually is "bottled sunlight."

In the elucidation of these facts, medical science called on all the fundamental sciences for aid.

Chemistry, physics, anatomy and physiology—each contributed its quota of fundamental information, and finally the clinician at the bedside was able to apply the facts discovered to the saving of human lives and to the healing of the sick.

A score of years ago there was a long list of diseases known as "idiopathic" or of unknown origin. Today the number has dwindled greatly and in only a few instances will medical scientists use the term at all. A careful search will, in most cases, reveal at least certain contributing causes, and the clearing up of these factors may, in many instances, result in influencing the attack of the body on the unknown primary cause of the disease. Thus it is that a cure has been reported in cases of epilepsy, pernicious anemia, and even of cancer, without operation on the latter, when the treatment given was not directed at any known cause.

In cancer particularly, much has been learned of contributing causes. Chronic irritation by rubbing, by heat, by chemicals, or by other methods, seems to

stir up cancer in certain areas in which it is likely to appear. In the history of that type of malignant tumor known as sarcoma, a severe blow may seem to be related to the onset of the disease.

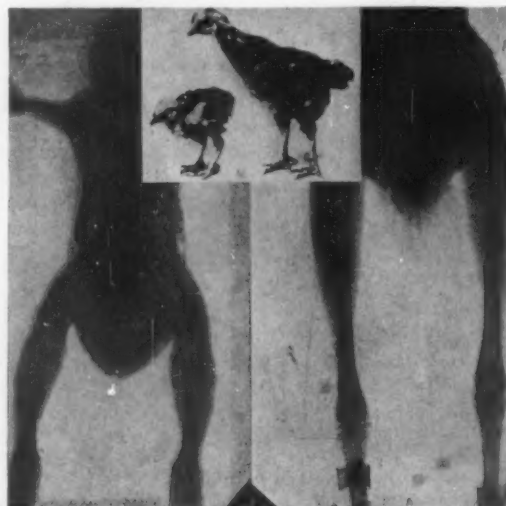
Cancers have been passed from one animal to another and it has been shown that heredity may play some part, although in the human being, marriages are so intermixed among various families, so far removed from the inbreeding of the laboratory experiment, that heredity is hardly an important factor, or one against which one may guard.

With this indication of the manner in which medical science is gradually beginning to determine the causes of many obscure conditions, let us consider the improvements that have come in the matter of diagnosis.

How Does the Doctor Diagnose?

As has already been mentioned, the physician in making his examination, first questions the patient thoroughly as to the character of his complaint and its duration, and as to the family history, in order to gain an indication as to whether or not hereditary factors may be involved. He then utilizes his ordinary senses for observation, studying the visible changes in the patient's physical condition. Through additions to the medical armamentarium, he is able to utilize mirrors and lights to observe directly the inner lining of the stomach, the bladder, the eardrum and the nose and throat. By means of the X ray, he is able to observe changes in solid organs within the body; and, through the injection of air directly into the abdominal cavity, or, in women, into the uterus, he is able with the aid of the X ray to outline organs heretofore not visible, and to determine the condition of organs like the tubes.

He passes to palpation, feeling the skin of the patient and attempting to ascertain by the sense of touch whether or not noticeable changes in anatomical structure exist beneath the skin surface. Obviously, it is necessary that he be thoroughly familiar with the normal character of the various parts so that abnormal conditions will be apparent. It is customary to introduce the hand also into



Courtesy Prof. W. T. Davis, after the General Electric Co.

NO ULTRA-VIOLET LIGHT, NO BONES

The small chicken received its sunlight through glass, the large one (same age), from a quartz lamp. Note the bones

various orifices whereby the "educated" finger may determine directly whether or not swelling or unusual conditions exist within organs not visible from the surface, or not even palpable from the surface.

The physician now uses the sense of hearing to determine whether or not organs are functionally active, and, if he is familiar with the sounds of such organs as they may be heard under normal conditions, he will be able to determine abnormalities; through hundreds of thousands of observations carefully recorded over many years, he will be able to relate such abnormalities to definite changes in the tissues concerned.

Again, he may apply the test of percussion, listening to get the note of response which comes when the tissue is struck, and to determine whether or not there exists beneath the skin a hollow cavity, a cavity distended with fluid or gas, or a tissue that is congested and inflamed.

To these senses as applied to the study of the human body, the physician now adds a vast amount of data securable from laboratory tests.

Pseudo-scientific Cure Fads

Specimens of the blood will show whether or not the body is properly assimilating its food and properly discharging waste matter. Tests may be made for sugar, for nitrogen or its products, for acid, and for alkali. The number of red-blood cells will indicate whether or not the patient is anemic or plethoric. The number of white blood cells, and the relative proportion of each type, will indicate whether or not the patient is suffering from some disease affecting the white blood cells; whether or not he has certain forms of inflammation which are manifested by an increase in the number of white blood cells; whether or not he has another disease, such as trichinosis—an infection derived from eating spoiled or infested pork, manifested by an increase in still another form of the white blood cells; or whether he is, perhaps, the subject of some disease manifested by a decrease in certain types of these cells.

The interpretation of the phenomena observed is a matter for a competent physician. Here some of the numerous varieties of cultists, who believe that all diseases are brought about by influences of the mind, or by pressure on nerves or ligaments, or by vibrations, or by any other narrowly restricted idea of the mechanism of disease causation, should begin to realize, that before such observations as have been mentioned, theories must be discarded.

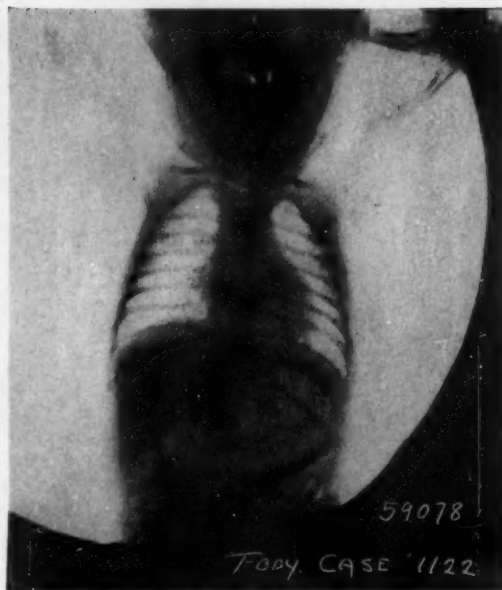
VITAMINS IN FOODS

	A	B	C		A	B	C
BREAD, WHITE (WATER)	+	+	+	TOMATOES (100 G. SERV.)	+	+	+
" (MILK)	+	+	+	BEANS, KIDNEY	+	+	+
" WHOLE WHEAT (H)	+	+	+	" NAVY	+	+	+
" (MILK)	+	+	+	" STRING (FRESH)	+	+	+
BARLEY (H)	+	+	+	CABBAGE, FRESH, RAW	+	+	+
CORN, YELLOW	+	+	+	" COOKED	+	+	+
OATS	+	+	+	CARROTS, FRESH, RAW	+	+	+
MEAT, LEAN	+	+	+	" COOKED	+	+	+
BEEF FAT	+	+	+	CALIFLOWER	+	+	+
MUTTON FAT	+	+	+	CELERY	+	+	+
PIG KIDNEY FAT	+	+	+	CUCUMBER	+	+	+
OLEOMARGARINE	+	+	+	DANDELION GREENS	+	+	+
LIVER	+	+	+	EGGPLANT, DRIED	+	+	+
KIDNEY	+	+	+	LETTUCE	+	+	+
BRAINS	+	+	+	ONIONS	+	+	+
SWEETBREADS	+	+	+	PARSNIP	+	+	+
FISH, LEAN	+	+	+	PEAS	+	+	+
" FAT	+	+	+	POTATOES (BOILED 15 MIN.)	+	+	+
" ROE	+	+	+	" (BAKED)	+	+	+
MILK, FRESH	+	+	+	SWEET POTATOES	+	+	+
" CONDENSED	+	+	+	RADISH	+	+	+
" DRIED, WHOLE	+	+	+	RUTABAGA	+	+	+
" SKIMMED	+	+	+	SPINACH, FRESH	+	+	+
BUTTERMILK	+	+	+	" DRIED	+	+	+
CREAM	+	+	+	SQUASH, HUSBARD	+	+	+
BUTTER	+	+	+	TURNIPS	+	+	+
CHEESE	+	+	+	APPLES	+	+	+
COTTAGE CHEESE	+	+	+	BANANAS	+	+	+
EGGS	+	+	+	GRAPE JUICE	+	+	+
ALMONDS	+	+	+	GRAPEFRUIT	+	+	+
COCONUT	+	+	+	LEMON JUICE	+	+	+
HICKORY NUTS	+	+	+	ORANGE JUICE	+	+	+
PEANUTS	+	+	+	PRUNES	+	+	+
PECANS	+	+	+	RASPBERRIES (100 G. SERV.)	+	+	+
WALNUTS	+	+	+				

+ contains the Vitamin
 ++ good source of the Vitamin
 +++ excellent source of the Vitamin
 - no appreciable amount of the Vitamin

VITAMINS ARE ESSENTIAL TO LIFE

Science has only recently learned that vitamins are as necessary to the diet as are the proper calories



Courtesy of American Medical Ass'n

X RAYS FOR LOCATING FOREIGN OBJECTS

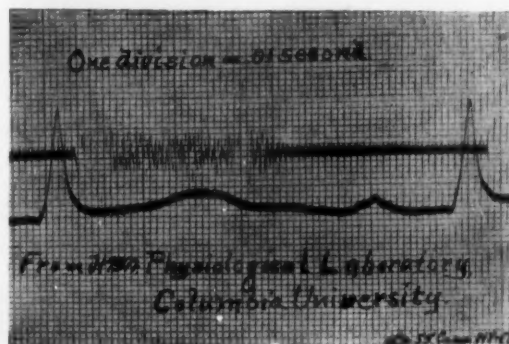
An open safety pin is lodged in the infant's throat. The radiograph also reveals the lung cavity and the heart.

To these simple laboratory tests the scientists may, in unusual cases, add complicated chemical and physical observations, such as the use of the electrocardiograph, to record electrically the waves showing variations in the heart beat. They may perform function tests of various organs, injecting dye substances or other chemicals excreted by certain organs or in a certain manner, and determine whether or not the organ in the patient concerned is performing its function as a normal organ should.

While it is safe to say that treatment of disease had advanced equally and coincidentally and, possibly, beyond the remainder of medical science up to fifty years ago, treatment was based largely on empiricism or observation of thousands of cases, rather than on any exact knowledge of the causes of disease or of the changes brought about by disease in the human organism. Beginning, however, with the scientific study of these latter factors, treatment also began to progress at a rate far beyond that which marked its previous progress.

As has been mentioned, medicine was already acquainted with the use of certain drugs which had a specific influence on certain diseases.

The use of mercury, not only in syphilis but also for purgative purposes, as in the use of calomel, was rather well known. Quinin had been shown to be a specific for malaria. William Withering had shown that digitalis has definite effects on the elimination of fluids, and it had been found that it had certain effects on the heart. Many other vegetable drugs had been demonstrated to have certain powers. As a result of the influence of Hahnemann and, still earlier, of Albrecht von Haller, certain drugs had been submitted to trial



Courtesy of American Telephone and Telegraph Co.

PATIENT'S BREATHING AND HEART ACTION

This combined electrostethogram and electrocardiogram was transmitted by telephone wire from New York to Chicago

under various conditions and their effects rather well established.

Chemistry had been progressing slowly but surely; new substances were being isolated and their effects promptly tried in medicine. However, nothing approximating the great discoveries of the past fifty years had been thoroughly and carefully worked out by the medical science of a previous day. Indeed, it required the scientific methods of the present day to prove just how the empirically used drugs of previous centuries brought about their effects.

Even today, drugs such as iron—used to bring about an increase in the red blood cells and the hemoglobin or oxygen-carrying material in them; arsenic—used to stimulate the production of new blood cells and for certain effects that are known as alternative; iodine—which brings about remarkable effects in the body under certain conditions; and many other drugs, are used without a perfectly established knowledge of their mode of action.

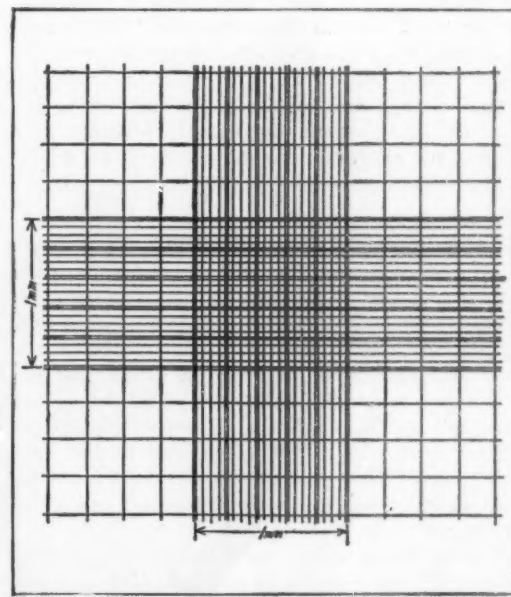
Common Dyes Kill Germs

On the other hand, the effects of arsenic for special attack on spiral organisms, as in the case of salvarsan; of chaulmoogra oil, which seems to have a special affinity for the organism of leprosy; of quinin in malaria; of quinidine in fibrillation of the heart; of digitalis, for slowing and intensifying the heart beat; and of phenolphthalein, for stimulating the action of the intestinal tract, are certain and positive, easily demonstrable to anyone who is willing to believe what he can see.

More interesting, however, in modern progress in drug therapy, is the recent attempt to bring about special actions on certain bacteria by the use of combinations of dye substances with antiseptics.

The outgrowth of these studies has been the bringing to light of such combinations as acriflavine, mercurochrome, flumerin and others, which have already shown indications of having special virtues in attack on infections with streptococci, staphylococci and colon bacilli, in cases heretofore resistant to drug therapy. Laboratory evidence has, indeed, indicated that such drugs as ethylhydrocuprein may have specific virtues in attacking the pneumococcus, particularly as it may affect the eye, or in other external infections.

In the next article of his interesting series, Dr. Fishbein will dwell on the future. What chance have we to prolong life? Can the progress in medical science keep up its present pace?



Courtesy of U. S. Bureau of Standards

HOW BLOOD COUNTS ARE MADE

Some diseases are diagnosed by counting the number of blood corpuscles, using this ruled glass cover as an aid



HOW THE MILKY WHITE FLUID CALLED LATEX OR RUBBER MILK IS OBTAINED

Plating Rubber, Just Like Metal

By a Remarkable Process, Recently Discovered, Rubber May be Electrodeposited on Metal, Wood or Cloth

By D. H. Killeffer

Secretary, New York Section, American Chemical Society; Associate Editor, Industrial and Engineering Chemistry

FROM the time we are received into this world by the rubber-gloved hands of a physician until our earthly remains are borne to their final resting place on a rubber-tired undertaker's cart, rubber touches our lives intimately. It has come to play an essential role in this drama which we call civilization, and hence it is that so much time and thought are being devoted to ways of making it more easily and exactly useful.

One of the recent results of the many researches that are being constantly devoted to rubber is a process for electroplating rubber, much as we are accustomed to electroplate metals.

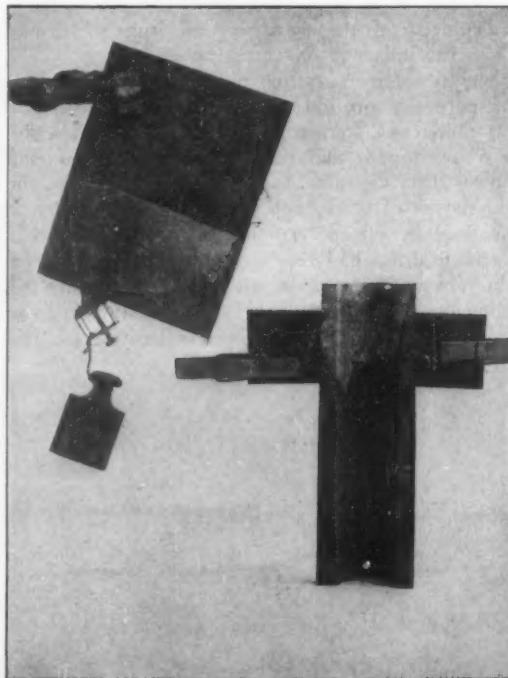
It Couldn't Be Done

At a recent meeting of the American Chemical Society, Dr. S. E. Sheppard and his co-workers announced that they had succeeded in depositing rubber, an excellent insulator, from suspensions or emulsions—no one is quite sure in which state rubber is—of rubber in water, upon the pole of an electroplating bath. Not only were they able to deposit rubber itself, but along with it they were able to make the electric current plate out all of the ingredients necessary to make it a proper and useful compound ready for vulcanization.

This process is one of those things that "couldn't be done!" Nevertheless it now bids fair to revolutionize a part of the rubber industry.

Before the new process can be completely understood, it will be necessary to think for a moment

about several things which are closely related to it and upon which it is based.



Courtesy of Eastman Kodak Co.

RUBBER COATING ON METAL

LEFT: Sheet about one-tenth inch thick, partly stripped, held down by one-half kilo weight. RIGHT: Metal conduit rubber-plated, partly stripped to show coating

First, we must think about colloids. Glue, gelatin and a host of other things are known in the language of science as colloids. The term colloid is derived from the Greek word for glue and it is used to describe a condition of matter which is somewhere between a solid, as we ordinarily think of such things, and a solution.

Process Eliminates Milling

Ordinarily, solids are crystalline, that is, they are made up of orderly arrangements of more or less closely packed molecules. But if we dissolve a solid in some solvent, such as water, we immediately separate it into particles very little, if any, larger than single molecules and often much smaller. Thus the solid loses all structure. On the other hand, if we mix a solid or a liquid with some liquid which will not dissolve it and if we grind the suspension very finely, we will ultimately reach a stage somewhere between a solid suspension and a true solution. Such a stage is said to be colloidal. In this state the particles of the solid are considerably larger than single molecules and they exhibit some very interesting properties. The most remarkable of these properties is, that the minute particles are capable of darting about freely in the liquid, and that they will readily take up electric charges and will be influenced by them. An electrically charged colloidal particle behaves very much like a charged ion of metal, produced by dissolving a metallic salt in water.

Now rubber latex, which is derived from the rub-



Courtesy of Eastman Kodak Co.

ELECTRODEPOSITION OF RUBBER

Mr. L. W. Eberlin (right) and Mr. C. Beal (left) electroplating rubber on fabric and on metals

ber tree is such a colloid, and it consists of minute globules of rubber surrounded by little sacs of protein, similar, for example, to the white of egg; and just as the electrically charged atoms of metal in a solution—metallic ions—may be attracted to an oppositely charged plate, so may the electrically charged particles in a colloidal suspension of rubber be attracted and made to stick to a plate.

We have noted that rubber is an extremely useful stuff, but it did not become so until nearly a hundred years ago when Charles Goodyear found out that it could be hardened and that its stickiness could be removed by heating it with sulfur. Every little while someone comes out with something or other represented to be made of "pure gum rubber." Strictly speaking, there is no such thing. Although the rubber that went into the product may once have been pure, it cannot be both pure and useful.

Pure rubber is purposely "adulterated" with a variety of things in order to make it fit to use. Sulfur, always, and a number of other things that give it desirable properties must be added to it, and then the whole mixture is subjected to a heat treatment, called vulcanization, before it ceases to be sticky and gummy.

In order to get these various necessary impurities evenly distributed in the mixture, this mixture is milled between large rollers that blend it perfectly and prepare it for vulcanization. If the rubber is to be properly uniform at the end this rolling must be done, but unfortunately this rolling process also materially reduces the strength of the finished rubber, and it therefore has to be minimized wherever possible.

Now we may return to Dr. Sheppard, who has succeeded in electroplating rubber. His process is quite simple, and the most remarkable thing about it is that no one has thought of it before.

A few years ago many investigators were looking for a method of getting rubber directly out of the latex of the rubber tree, and one of them chanced upon an electrical method of doing it. He added a little ammonia to the milky latex. Thus he succeeded in producing the desired negative charge on each of the tiny globules of rubber in it. This accomplished, it was comparatively simple to plate the rubber out. Unfortunately, however, the Orient where most of our rubber is now grown, is not supplied with bountiful electric power. Nor was the electric process particularly economical in other respects.

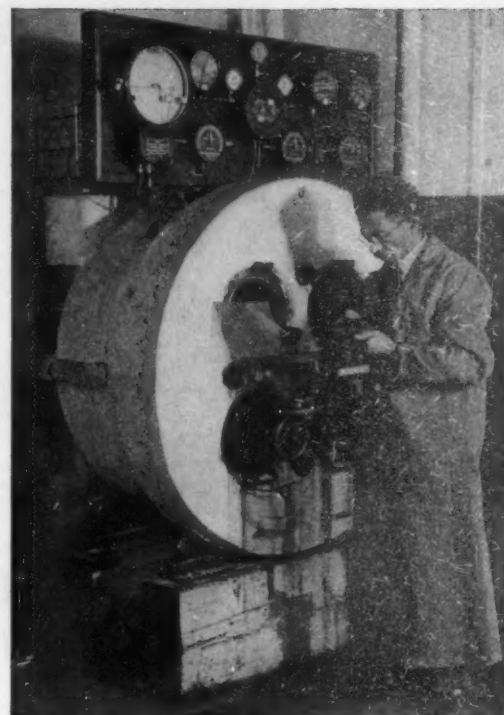
Dr. Sheppard, working on the other side of the world, came upon this discarded method and added to it just the one thing needed for success—he made the remarkable observation that he could mix all the necessary impurities into the latex, along with a little ammonia, and then electroplate a coating of rubber all ready to vulcanize without milling! It seems that the little albuminous sac surrounding the minute globules of rubber latex will absorb the impurities readily. Therefore, the rubber layer, as plated out of the solution, is already mixed even better than prolonged milling would do it.

Makes Seamless Garments Possible

In addition to being able to use the latex just as it comes, it was found that a colloidal suspension of rubber prepared from scrap, which has always been difficult to handle, would behave in the same way. This provides a useful way to utilize this scrap. The reclaimed scrap rubber is simply mixed with some solvent, emulsified with water and finely ground to make the whole colloidal.

Once the solution is properly prepared, with the sulfur and pigment added, it is only necessary to put two plates into it, connect them up with a source of direct electric current, and out comes the layer of rubber on the positive plate (the anode).

The voltage used may be almost anything up to more than a hundred volts, and the current density may be anywhere from two one-thousandths of an



Courtesy of Eastman Kodak Co.

ELECTRODESPOSITED RUBBER IS VULCANIZED

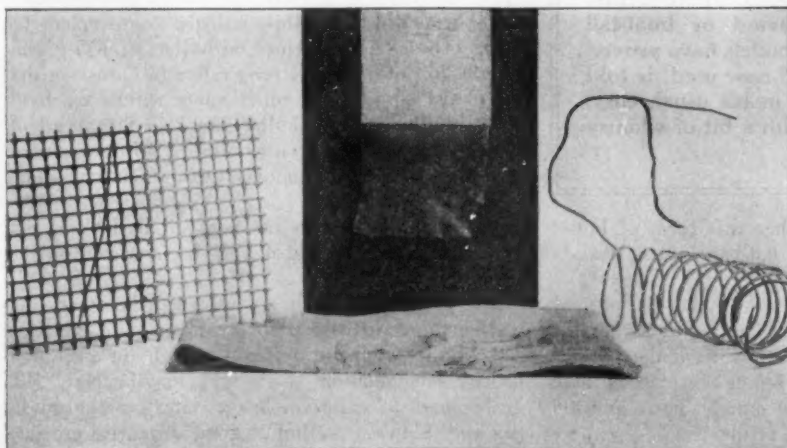
Dr. S. E. Sheppard is here seen examining rubber-plated fabric after it has been cured

ampere up to one ampere per square inch, without seriously affecting the nature of the coating (something less than half an ampere per square inch is best).

After vulcanization, the electroplated rubber has even more strength than similar rubber prepared by the ordinary methods. Plates as thick as one-fifth of an inch after vulcanization are readily deposited and there is no reason to believe that that is the limit in thickness.

The surprising point about the whole thing is that quite as good a coating can be put on cloth or wood as on metal. Soon we will undoubtedly be wearing rubber overcoats, electroplated without a seam in the rubber after the cloth body has been completely formed.

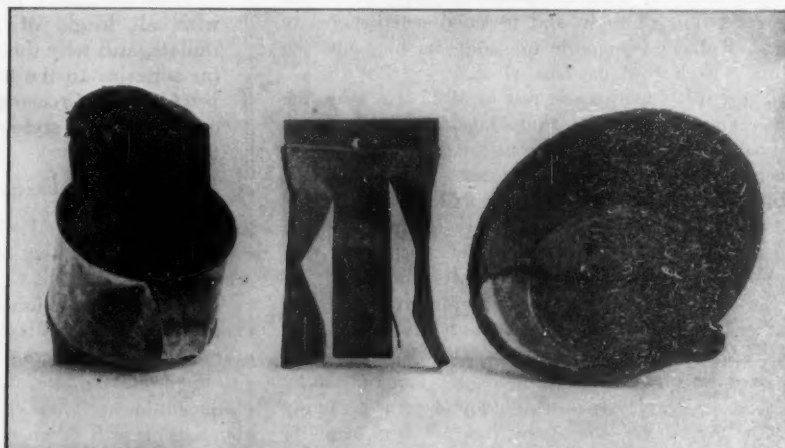
Electrodeposition on collapsible forms offers other new possibilities, particularly in view of the way that the rubber coating spreads itself evenly over the whole—it has great "throwing power," in the words of the electroplater. No end of other things may be similarly made without seams in the rubber, seams which might open and make leaks. An entirely new group of possibilities in seamless rubber articles is opened to the manufacturer by this process.



Courtesy of Eastman Kodak Co.

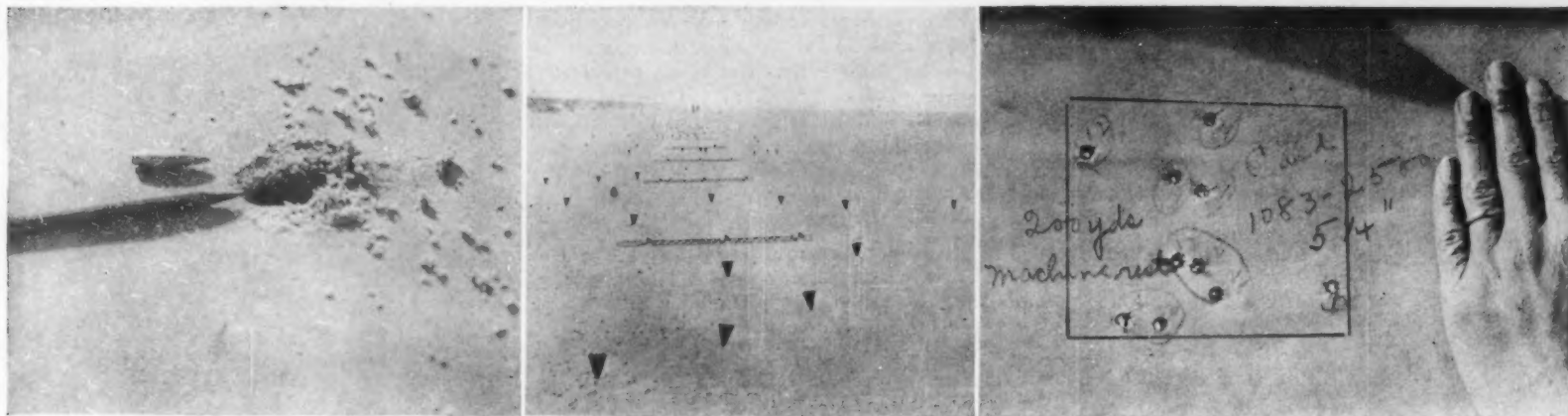
RUBBER COATING IS APPLIED TO VARIOUS TYPES OF OBJECTS

LEFT: Metal wire gage, rubber-plated; screen one-quarter inch mesh, 18-gage wire. UPPER CENTER: Sheet metal rubber-plated. LOWER CENTER: Mercerized fabric rubber-plated. Rubber coating one-fifteenth inch thick. RIGHT: 20-gage wire rubber-plated



Courtesy of Eastman Kodak Co.

LEFT: Metal cup rubber-plated inside. The coating has been partly stripped away. CENTER: A piece of bent and twisted metal sheet rubber-plated, to show throwing power. RIGHT: Metal pan, rubber-plated, with coating partly stripped away



THE BOAT-TAIL BULLET IS PARTICULARLY EFFECTIVE AT LONG RANGE, AND VERY ACCURATE AT SHORT RANGE

LEFT: The boat-tail bullet strikes the sand at three miles and is dug out. Note its shape closely. CENTER: A machine-gun "burst" at a range of one and one-half miles. The triangles mark the individual bullets. RIGHT: A group of hits at 200 yards from the Mann rifle rest shown on the opposite page, illustrating the accuracy of the boat-tail bullet

The Arrival of the Boat-tail Bullet

Government Tests Show that the New Shape of Bullet Practically Doubles the Effective Range of a Rifle or Machine Gun

By Captain Edward C. Crossman

Late, United States Army Small Arms Ballistic Station

LAST spring a flock of boat-tailed bullets, made and loaded into service ammunition by the Government Frankford Arsenal, shot a flock of holes in the one remaining objection to this type of missile—its comparative inaccuracy.

With ten-shot groups of hits at 328 yards, which averaged so uniform that they fell within a small rectangle, 1.88 inches from top to bottom, and 2.33 inches from side to side, the Frankford Arsenal proved that the ideal missile with its taper-tail, could also be made into the most accurate of bullets. Not satisfied with this extraordinary showing at 328 yards, the government gentlemen, in competition with the great commercial ammunition companies, proceeded also to win the ammunition test at 1,000 yards with the same bullet, the groups at this range averaging to fall within rectangles measuring 11.54 inches by 11.43 inches.

For several years one of the commercial companies had won this test with hand-selected, flat-base bullets 180 grains in weight, and with a velocity between 2,600 and 2,700 feet a second.

Our Army Bullets Are Obsolete

The boat-tail bullet, admittedly superior in its lessened time of flight and lessened sensitiveness to wind, had not been able to group its hits quite so closely as its old flat-base rival.

Thus, this machine-rest test of 1925 sets aside the one remaining objection to the boat-tail bullet. When a boat-tail bullet of wonderful ranging qualities can be made to give the same averages just quoted, for 26 strings of ten shots each at 328 yards, and for 24 strings at 1,000 yards, then it is apparent that the taper-tail missile is with us to stay.

For three years the boat-tail bullet, of about 170 grains, has been loaded in the ammunition designed for our national rifle matches, about two million cartridges per year.

Because of the enormous stock of war ammunition remaining—nearly two billion rounds at the signing of the Armistice—the Army has not been able to load any additional ammunition save that intended for these great rifle matches. Wherefore, the official service cartridge of the Army is still the 150-grain, flat-base bullet combination, the standard since 1906.

Unofficially, this light, flat-base bullet with its poor ranging qualities for machine-gun work, is deader than King Tut's chances for the Presidency.

The National Match boat-tail ammunition, while high in accuracy and of splendid wind-bucking qualities for long-range target shooting, had never been able, in the special match form, to beat the products of the commercial loading companies in the open machine-rest tests, and it had produced doubt

Why the Boat-tail Bullet?

You can tow a tapered log easier and faster butt end first than point first. Unreasonable? Try it.

The speedy clipper ships by which the Yankee gained the commercial ascendancy in the tea traffic a century or so ago had a longer taper aft than forward.

The rifle bullet seems to be governed by roughly similar principles. Take the bullet used at present by the United States Army, change its square rear end or stern to a taper, and you get remarkably improved results from it.

How the Army has been experimenting with all kinds of tapered or boat-tail bullets, and why these bullets have proved far superior to the kind now used, is told by Captain Crossman in his usual, easy, conversational style, with a bit of whimsy thrown in.

in the rifleman's mind whether this form of bullet ever could defeat the old flat-base in a straight accuracy test.

A little contemplation will show the difficulty of making boat-tail missiles shoot as accurately as the older type. The portion holding back the powder gas in the bore of the gun is not the extreme base of the bullet as it leaves the muzzle, but a portion about one-fourth of an inch farther forward, where the major diameter of the bullet is located.

When this leaves the muzzle, with the "tail" still on its way out, the gas, under the muzzle pressure of around 9,000 pounds per square inch, proceeds

to rush out past the tail. If the bullet is not traveling precisely parallel to the line of bore, due to eccentric seating in the chamber, or if the tail is not exactly concentric with the rest of the bullet, the gas proceeds to give it a violent twist one way or the other. This is not conducive to high accuracy.

With the flat, or square-base bullet, all that is necessary for perfect and uniform muzzle delivery is to make sure that it is seated correctly in the rifle barrel, and that the base of the bullet is perfect and at right angles to the long axis of said bullet. This is easier than making a quarter inch of tail with the same accuracy of form and place. Evidently the Frankford gentlemen have solved the latter and harder problem.

Since the war, the slight taper on the tail of the rifle bullet has proved to be the greatest development in small-arms missiles since the discovery by the Germans and Sir Charles Ross of the efficacy of the sharp point, about 1905. For very long-range, machine-gun work the boat-tail feature is far more important, even, than the sharp point.

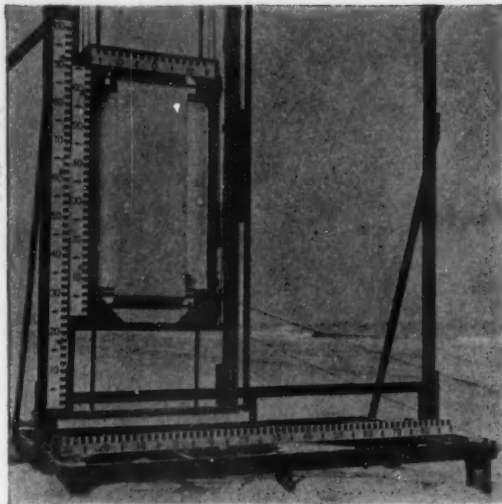
Germany Used the Boat-tail Bullet

The virtues of the boat-tail bullet were impressed upon the Allies in 1918 by the kindly disposed Germans, who illustrated this ballistic improvement by flocks of boat-tail machine-gun bullets of 195 grains weight, put over at very long range in harassing fire on roads, dumps, and other spots within reach of such missiles. These bullets were so far ahead of the former German service bullet of 154 grains that the Allies were much annoyed at this Teutonic scientific advance.

But even at that time the boat-tail bullet was not new. Its sweetness had merely been wasted on the desert air.

The French solid bronze bullet had been wearing a slight taper to its tail for years prior to the war. This bullet, however, was so high in sectional density—its relation of weight to diameter, 198 grains, and .32 calibre—that its long ranging qualities and its heavy wallop at great distance were due more to this density than to its tail.

The Swiss had designed a perfect boat-tail bullet six or seven years before the outbreak of war, a missile that stood unrivalled until the appearance



HOW THE HITS ARE RECORDED

On this angle-of-departure screen the angle of departure from the rifle of each hit is measured with a transit

of the recent United States nine-degree taper boat-tail. Our ordnance people knew about it, and had tested it, but unfortunately the ordnance experts were barking up two wrong trees. The first one was the dictum of solemn military conservatives that 1,000 yards marked the useful range of the rifle bullet, even in the machine gun; and that they didn't give two hoots what the bullet did at a greater range.

The second one was the erroneous conclusion that they could calculate from short-range figures, the entire flight of the bullet. This error, never checked by long-range firing, resulted in the solemn dictum in the textbooks of our rifle that our service bullet had a range of about 5,000 yards. As a matter of fact this is roughly one mile greater than the actual extreme range of our light service bullet, as firing in France and in this country during the war, speedily proved.

The fact that the ordnance experts of this and other countries took no interest in long-range bullet performance was back of the unfortunate errors in our range tables, and in the failure to discover the wonderful properties of a taper on the tail of a small-arms bullet.

As a civilian enthusiast, I was one of those who did not find out that the Swiss boat-tail was superior to the regular type; but of course I lacked the opportunity for the long-range firing which alone could demonstrate the qualities of taper-tail bullets. Before our entrance into the war, Major L. B. Moody, Ordnance Department, then in tank and car work at Rock Island Arsenal, sent to me a quantity

of the Swiss boat-tail bullets and suggested that I load them up and see if they showed anything unusual. The Swiss bullet is practically the diameter of the American, and fortunately fits our service rifle.

Our firing at 1,000 yards showed that the Swiss bullet required about three minutes of arc, less elevation, than the same bullet in flat-base form, and did not shoot so accurately, all of which checked with the conclusion of other experimenters that there was nothing to the boat-tail but a glittering hypothesis.

I do not know whether the Swiss themselves ever knew just what their boat-tail bullet could do. If they did, they never published it to the world.

It required the practical demonstration by the Germans of just what a boat-tail bullet would do. This, and the obvious error in our tables for the service cartridge, led to the establishment by our Government of the Small-arms Ballistic Station, located first at a reservoir in Massachusetts and later at Miami and Daytona, Florida.

The *piece de resistance* of this experimental boat-tail bullet work was a duplicate of the Swiss bullet, but termed the U. S. Model 1919. This bullet weighed 175 grains, and had a slightly longer point than the American service bullet and a taper tail of six degrees. This bullet consists of two tapers, the bow taper and the stern, joining at the major diameter of the bullet about .28 inch from the base. There is no "parallel" or cylindrical portion as with flat base bullets of the same weight.

Doubles the Bullet's Effective Range

We also did extensive vertical firing at Miami and Daytona, shooting a machine gun straight up into the air to determine the time of flight for the round trip up and down, and to determine the position of the bullet when returning. The boat-tail bullets developed a queer tendency to separate and return in two distinct flocks, one of them requiring slightly more than one minute, the other flock returning in 50 percent more time. Our suspicion that some of the bullets sat down on a cloud to rest was cleared away by the firing on the Daytona sand later on, and the discovery that some of the boat-tails were falling sideways, hence were offering much more air resistance and requiring much longer to make the trip from the heights to the ground. Evidently the boat-tail bullet flies in a critical state of balance and requires much "spin" in order to keep itself spinning "point-on." Firing for penetration corroborated this, the bullet turning sideways at the least provocation and diving at sharp angles out of the penetration racks. This tendency would greatly



SURE-KILLING ANGLE AT 4,000 METERS

At two and one-half miles the trajectory is still comparatively flat, as shown by the angle of the pencil

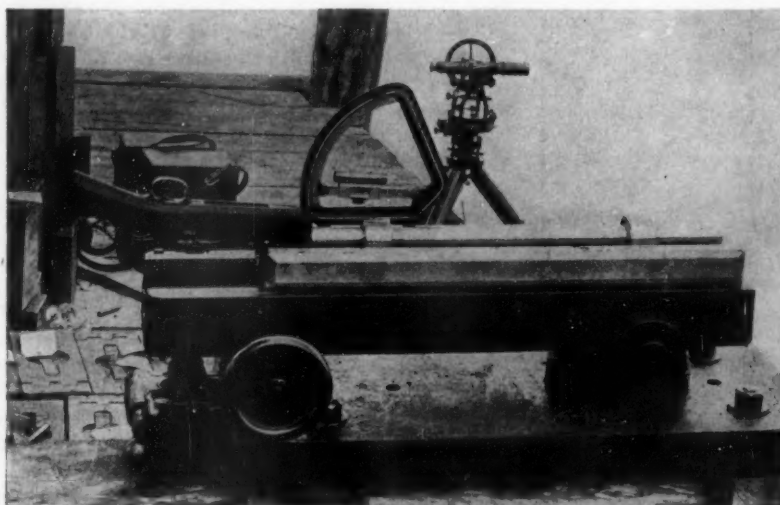
increase its wounding and killing qualities in war.

The feature of the boat-tail bullet is the fact that its ballistic superiority does not show to any marked extent until its velocity has fallen to 50 percent or so of the velocity at which modern bullets start from military rifles. Over the first 1,000 yards of range it shows no marked flattening of its flight.

Beyond 1,000 yards, however, where the speed of the ordinary military bullet has fallen to an extent where the effect of the sharp point is comparatively small, the boat-tail really commences to get interested. Roughly speaking, the present model of 1924 U. S. nine-degree, boat-tail bullet of 172 grains weight, leaving the rifle at the same velocity as that of the 150-grain service bullet, practically *doubles* the effective range of machine gun or rifle.

At 3,000 meters the present square-tail, 150-grain service bullet is through. It is falling at such an abrupt angle, and traveling so slowly that often no trace can be found of a long machine-gun burst of fifty shots or more, because some vagrant zephyr has drifted the bullets clear off their original line. Generally speaking, about 2,700 yards marks the practical range of the present war reserve ammunition, in machine guns.

The virtue of this remarkable bullet is not only in extending the effective range, but in greatly increasing the chances of a hit because of its flatter trajectory, and of inflicting fatal wounds because of its enormous increase in remaining energy and penetrative ability. Indeed, comparison between the two types of missiles is really pathetic.



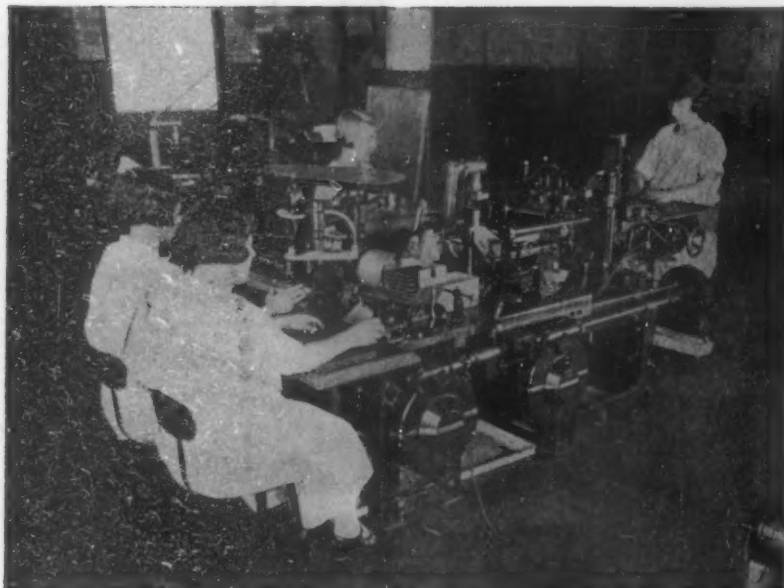
THE HEAVY, SPECIAL BARREL IN THE MANN REST, READY TO FIRE

This is the method used in the 1925 ammunition tests. The surveyor's transit measures the angle of departure of each bullet, as explained in the illustration above



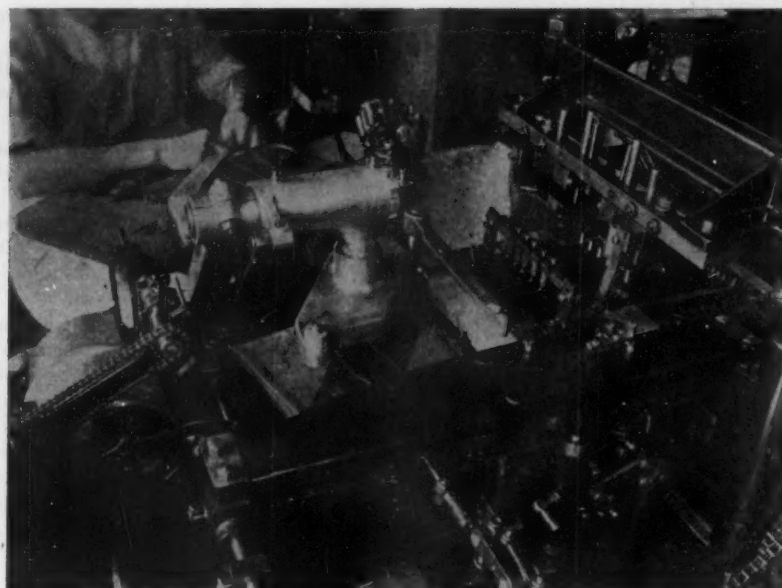
CONDUCTING EXPERIMENTAL MACHINE GUN FIRING FROM THE MANN REST

This picture was taken at the United States Small Arms Ballistic Station, Daytona, Florida, where some of the tests of the boat-tail bullet were carried out



A LONG FILLER CIGAR-MAKING MACHINE

This machine, which cost over \$7,000,000 to develop, is so constructed as to utilize either the right or left-hand sides of the wrapper. Four girls, working on this machine, produce 500 cigars per hour



THE HEART OF THE MACHINE

In the center will be seen the filler, ready to be rolled. The binder is immediately in front. The girl has just prepared a binder leaf, which is held by suction awaiting the pneumatic transfer arm

A Machine That Is More Than Human

An Amazing Electro-mechanical Device Which Distinguishes Between Thirty Different Shades

By Albert A. Hopkins

THE retail tobacco trade is another billion dollar American business. Yet tobacco is not, in any sense of the word, a necessity! Year after year the number of smokers increases—faster than the ratio of population increases: This, due to the fact that so many women are smoking now. Note the amazing figures of production for the past year: over seven billion cigars; over seventy-five billion cigarettes; over four hundred million pounds of smoking and chewing tobacco and snuff.

A Dream Becomes a Reality

To the layman, the question promptly will come to mind, "How on earth were these products made, and where? Surely not in the little hole-in-the-wall tobacco factories I have seen while strolling around various cities?" Certainly not, for one thousand cigars constitutes a good day's work for two skilled hand operators in such factories. Seven billion cigars a year would require at that rate, some forty-seven thousand skilled cigar makers alone for this country. A rapid cigarette maker, using paper tubes, already formed and pasted, can make about four thousand cigarettes per day. At that rate, America would need some sixty-two thousand five hundred skilled cigarette makers. Add to these figures the workers in other classes of manufactured tobacco—the army of people engaged in growing, harvesting, curing and conditioning the tobacco—and it will be readily seen that hand-manufacturing is not the answer. Automatic machinery alone makes this huge production possible.

Over twenty-five years ago a cigar maker dreamed of a machine that would make a perfect long-filler cigar. His fellow-workers laughed him to scorn, for his ideas were visionary. Yet in time his enthusiasm spread, and he found backers. Scores of talented engineers and highly skilled mechanics worked for two decades to develop his idea. Oscar Hammerstein, the great impresario (who was at one time a cigar maker) contributed many ideas and a great deal of money to this work. Model after model was built, each just a little short of perfection.

Finally, after almost seven million dollars had been expended, the dream became a reality.

Last year, this machine actually made about one billion long-filler cigars. Utilizing practically any kind or grade of filler, binder or wrapper tobacco that is used for hand-made cigars, it makes a complete, headed cigar in one continuous series of operations. The cigars are uniform in size, shape and weight. The binders and wrappers are cut and applied so perfectly and carefully as to make a "leaky" cigar practically impossible. The filler is placed in the "bunch" in such a manner as to insure free burning throughout.

In operation the work proceeds as follows: An operator feeds the filler crosswise on a slow-moving conveyor belt, chopping the tobacco to proper length by means of two cutting knives as the belt moves. Corrugated rolls compress the tobacco and pass it to apportioning knives, where just the right amount of filler for each cigar is cut off. At this time a little triangular nick is cut out of each end of the

filler bundle, to permit the ends to be tapered in finishing the cigar. Each bundle of filler then passes separately to a loose belt which rolls the filler into a "bunch," at the same time wrapping around the bunch a piece of binder which has meanwhile been transferred by an arm from the cutting table where a second operator spreads out the binder leaf. The "bunch" now in the binder, is rolled thoroughly, and passed on to the point where the delicate wrapper leaf, which has been placed, cut, and transferred in a manner similar to the binder, meets it. Here the wrapper is spirally wound around the bunch, the conical head formed and sealed, and the other end clipped off straight.

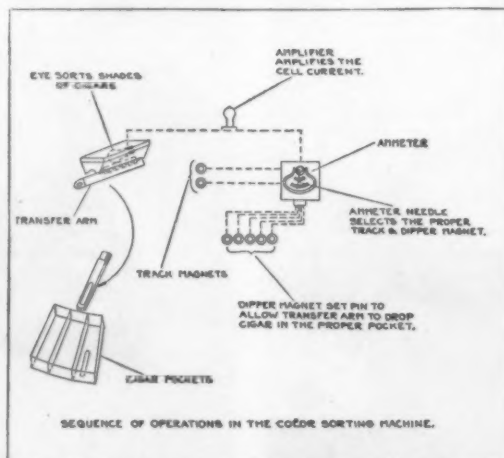
Thus, three semi-skilled operators and an inspector make about five hundred uniform cigars every hour, equalling the finest hand workmanship of skilled craftsmen.

Light Actuates the Electric Eye

Now that we have our cigar it is necessary to grade it for color. It would never do to send out a box of cigars with some of them "claro" and some of them "maduro." We have often seen girls in the factories of Cuba and Porto Rico sorting the cigars into some eight shades and we admired their skill. Now a machine comes along which can sort into thirty different shades. It seems almost uncanny, but it is really based on interesting scientific principles.

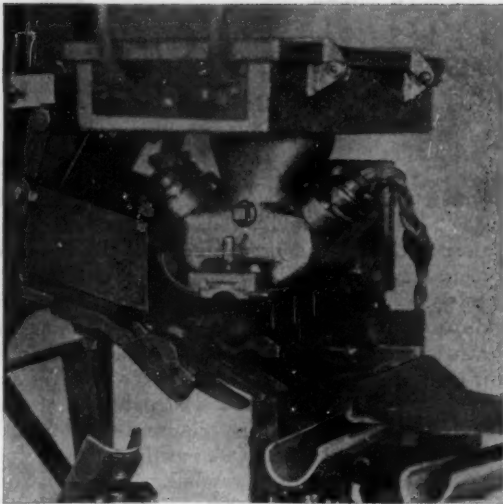
One operator controls this whole machine and his or her duty is to watch and see if everything is working smoothly. The machine consists of a finger which picks up each individual cigar, a photoelectric "eye" which measures the color, an amplifying panel which boosts the infinitesimal current generated in the eye, a switching ammeter which actuates the mechanical sorting mechanism and a set of thirty compartments, arranged around a common center, into which the cigars are skillfully passed by the electric sorter.

The cigars are fed, either by hand or from a conveyor belt, into a hopper which is slightly wider than the length of the cigars, and mounted above and to the side of the photoelectric cell. From the



HOW THE MACHINE WORKS

Diagram showing the various operations of the electro-mechanical cigar-sorting machine. This machine accurately determines thirty shades of color of the tobacco leaf which makes the wrapper of the cigar



THE PHOTO-ELECTRIC EYE

After the photo-electric cell has decided "Claro" or "Maduro" the cigar is sent to a compartment of the sorting table

bottom of this hopper an ingenious split finger picks the cigars one by one with meticulous care and carries each to the bottom of the eye.

The eye is a tube similar in shape to a small X-ray tube, with two terminals connected to a battery. One terminal is enlarged within the tube and heavily coated with potassium. The entire tube is covered by a light-proof case, and in the darkness no current flows between the two terminals. Light, however, activates the potassium-covered terminal, causing an emission of electrons which permits current to flow. In two words, therefore, this eye is simply an electric switch, opened and shut by light and darkness.

Below the eye is another chamber containing four small electric light bulbs, shielded from the tube above. When the finger places the cigar in position within this lighted chamber, a shutter opens a slit in the covered tube-chamber above it, and only the light which is reflected from the wrapper of the cigar is permitted to act upon the tube.

Obviously, the darker the color of the cigar, the less light will be reflected upon the tube, and *vice versa*. The actual color of the cigar, then, determines the amount of current permitted to flow between the two terminals of the tube. And, since every color reflects a different amount of light, it is readily seen that the only limit to the color-sorting abilities of this machine lies in the minuteness with

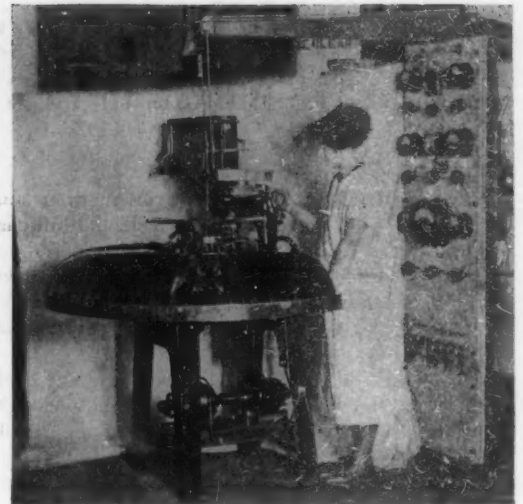
which these varying amounts of current, sent through the tube, can be detected and caused to operate the mechanical sorting apparatus.

The current actually flowing in the tube circuit is, of course, so small that it cannot be depended upon to actuate any mechanism. It is therefore sent to an amplifying panel placed near the machine, where the same type of apparatus used in transcontinental telephony is used to boost the current to usable proportions. From the amplifying panel the electric current, still so small that it will not make a tiny motor work, in spite of this boosting, is led to an extremely sensitive switching ammeter. In this ammeter the current is just heavy enough to swing the needle over a small arc. But the swing of the needle is divided into six major divisions, each of which in turn is broken up into five parts, and the whole thirty divisions thus made have each an interlocking terminal.

Five Hundred Cigarettes Per Minute

There is a "dog" or extension catch depending from the extreme end of the ammeter needle so made as to fit into the interlocking terminals of the thirty divisions of the switch. When the eye is viewing a cigar, the ammeter needle swings freely, until it comes to rest at a point on the scale corresponding to the current caused to flow through the potassium-terminated tube. Then two jaws, working from either side of the ammeter switch, close in and cause the dog on the end of the needle to make contact with the particular switch terminal located opposite the point at which the needle came to rest. After this a heavy current is passed through the needle, dog and proper terminal (now forming a closed circuit) and it is this current which sets certain magnetic trips on a circularly moving sorting table, causing the cigar (now being carried on this sorting table) to be passed unerringly into the proper compartment corresponding to its color.

The standard cigarette machine is entirely automatic in operation; by which is meant, that no portion of the cycle of operation is dependent on the human touch. At one end of the machine is mounted a roll of cigarette paper—a continuous strip of tape the width of a cigarette when laid open. This feeds under the tobacco hopper, where delicately adjusted gates deposit the tobacco in the middle of the moving tape. After leaving the hopper the tape passes through a conical former, which turns up the sides of the paper and shapes it into an endless cylinder, with the joint pasted and the tobacco inside. Then



THE CIGAR COLOR-SORTING MACHINE

This machine does the work of several girls. The cigars are fed by hand or conveyor belt, at the rate of sixty an hour

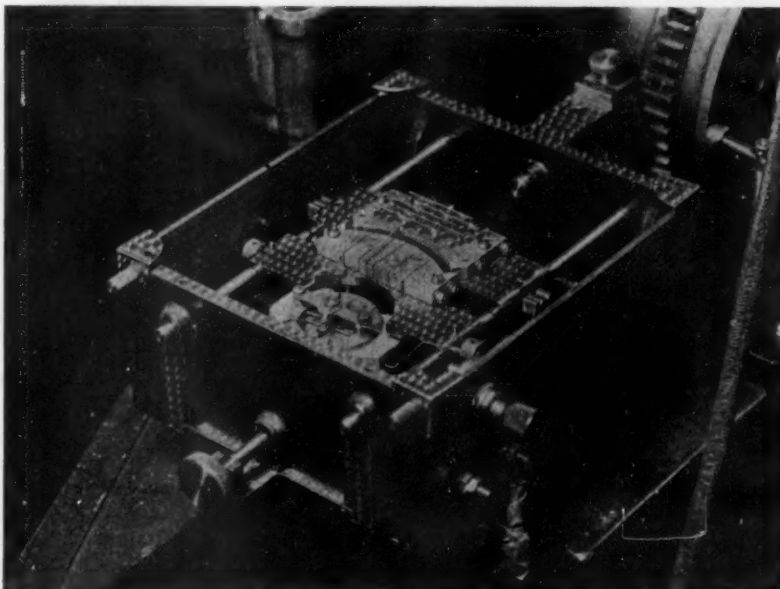
this endless cylinder passes under a swiftly revolving cutting knife which cuts off cigarettes of the proper length.

For special finishes, two devices may be added to the machine. One is a monogram printer, which is simply a wheel on which the printing die is mounted, and an inking attachment. The printing wheel makes the required impressions on the moving tape at spaced intervals corresponding to the length of each cigarette, before the tape reaches the hopper containing the tobacco. The other is a cork—or silk—tipping attachment.

The cork or silk material is made up in a roll similar to the paper, and mounted at right angles to the paper tape, and below it. As it is fed upward to meet the paper tape, one side is coated with paste. It is then passed over a wheel having cutting edges spaced apart at intervals corresponding to the width of the tape. Finally this wheel applies the cut piece of cork or silk to the paper tape at intervals corresponding to the length of each cigarette. The normal speed of the machine is five hundred cigarettes per minute, plain, printed, tipped, or printed and tipped.

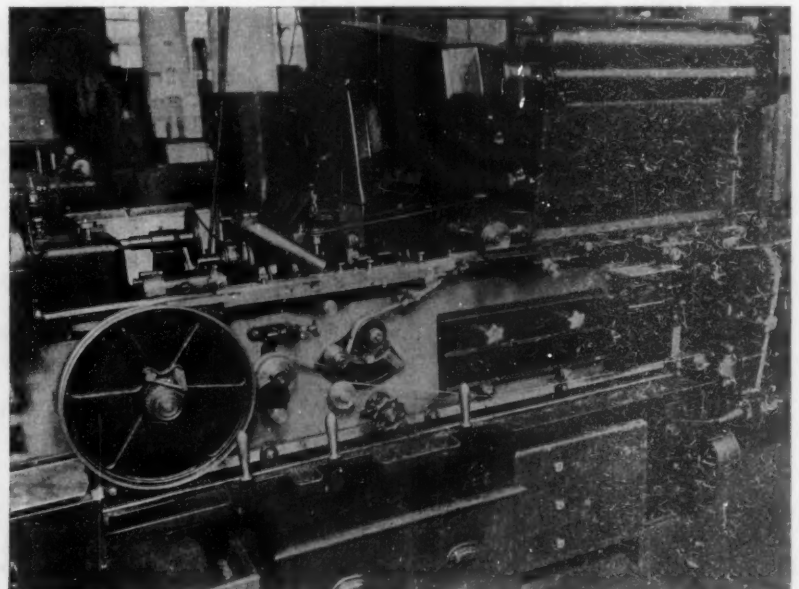
One operator can easily take care of several machines.

We are indebted to the American Machine and Foundry Company for an opportunity to make photographs of these intricate machines which they have developed.



HOW THE SORTING IS ACCOMPLISHED

A switching ammeter obeys the findings of the photo-electric cell and routes the cigar to the proper tray



FIVE HUNDRED CORK-TIPPED CIGARETTES A MINUTE

The endless tube, filled with tobacco, with cork bands at intervals, moves along until cut up into cigarettes

What Becomes of Your Railroad Fares

The Billions that Go Into the Railroad Treasuries Pass Out Quickly to Turn the Wheels of Industry

DOUBTLESS you have often wondered what the railroads do with the billions of money which they receive in freight rates and passenger fares. In a recent address before the Pittsburgh Traffic Club, Mr. P. E. Crowley answered this question as follows:

"The public has heard in the past a great deal about what the railroads take in but not enough about what the railroads pay out, with the result that in some quarters there is, perhaps, an impression that money once paid into a railroad till stays there and is lost to the world. The more than six billion dollars which the railroads received in 1923, and the lesser sum which they received in 1924, hesitated in the treasuries of the carriers hardly long enough to be counted before they hurried out again to help turn the wheels of industry and commerce and to support the life of the country. Very few of these busy dollars gravitated to the stockholders, or to the owners of the railroads. As a matter of fact, the carriers as a whole have been unable to earn the amount prescribed by the Interstate Commerce Commission as a fair return on the value of property devoted to public service under the Transportation Act of 1920. Furthermore, something more than one-third of the railroad mileage of the United States has never been able to earn any dividends whatever.

A Pay-roll of Three Billion Dollars

"In studying the division of the railroad dollar let us begin with wages, since they have a first claim upon receipts. Twice a month the great family of railroad employees receive their portion of revenues. In 1916 this portion amounted to substantially 41 percent of total operating revenues. In 1923 aggregate compensation of employees called for nearly 48 percent of total operating revenues. If you would realize how widespread this distribution is remember that one person in each 25 gainfully employed is carried on the railroad pay-roll. Of the aggregate amount collected by Class 1 railroads from the public in 1923 more than three billion dollars was disbursed in semi-monthly installments on pay-roll account. The greater part of this huge sum was at once distributed through the channels of trade. Either through investment or in payment of current living expenses all of it was kept busy. Not a dollar was permitted to idle its time away in an unproductive till.

"Having provided for the pay-roll the railroads have left of the average dollar received a fraction more than 52 cents. From this, must be deducted about eight and one-half cents to pay for locomotive fuel. In 1923 this included \$455,000,000 for soft coal. Now, since the railroads consumed 28 percent of all soft coal mined, it follows that the equivalent of 28 percent of the entire number of bituminous coal miners are as directly dependent upon the railroads for a living as if their names were carried on a railroad pay-roll. The equivalent of 205,000 coal miners with their families look to the railroad as their only visible means of support. Equally dependent upon the railroads for their daily bread are the 219,000 workers required to produce the 30 percent of iron and steel consumed by the railroads. These workmen and their families are exclusively supported by money collected from the public in freight charges and passenger fares. In the same way approximately 127,000 men are, in

effect, employed and paid by the railroads to produce the 25 percent of the national output of lumber which the carriers annually require.

"We must include in the list of those who are exclusively supported by the money received for freight charges and fares the employees of car and locomotive works to the number of 70,000. These workers constitute an important division of the railroad army, although their names do not appear on the railroad pay-roll. In the last two years alone the railroads of the United States have purchased locomotives and cars of the aggregate value of \$1,195,220,000.

Who Gets the Railroad Wealth?

It is seldom that the head of a great railroad corporation takes the public into his confidence by opening his ledgers and allowing every citizen to look them over to his heart's content. This is what President Crowley, of the New York Central lines, has done in the remarkable address which is printed on this page. There has been an enormous amount of false propaganda regarding the railroads or the "interests", to use the term of reprobation which the matchless Mayor of New York City loved to apply to the industrial commercial activities of the day. The "dear people" have been told that the railroads are shamelessly exploiting the public and increasing rates in order to increase the volume of the golden stream which flows into the pockets of the capitalists who are supposed to own the railroads. Well—Mr. Crowley, in his clean-cut analysis, shows that the golden stream passes through the treasury of the railroad with scarcely a halt, and flows back for the benefit of the people at large. Thus is one more lie of the propagandist nailed to the wall.

"If we add together the various classes of workers I have enumerated which are wholly supported by the railroads though not actually on the pay-roll, we have an army of 621,000 workers. Multiply this number by 4.3, the average number of persons per family according to the census of 1920, and we have a population of 2,672,000. Add railroad employees and their families calculated on the same basis and we find that about one-tenth of the population is included in these categories which are exclusively supported on the money which the railroads collect from the public. In addition to the few major items already enumerated the railroads also consume 10 percent of all the copper and brass and varying proportions of an astonishingly long list of other articles.

"Perhaps a few details about the curious variety of railroad supplies may be of interest. Take horses, for instance. The manager of purchases is obliged to understand the good points about a horse in order that he may expend company funds wisely. He must be informed about automobiles, for they, too, have been found essential in the transaction of railroad business.

"Manufacturers of fireworks have a lively interest in the purchasing power of railroads, for a sub-

stantial part of their sales—\$1,300,000, in fact—is made up of fuses and torpedoes which observant passengers may sometimes see flagmen place for the protection of trains. Textile manufacturers, too, are interested. Something like two million dollars of railroad earnings is required to pay for dining car linen annually and more than half as much goes for china. Then there is the linen for sleeping and parlor cars. Even the modest signal flags of red, blue, green or white bunting require 2,400,000 yards of material costing \$300,000 annually.

"Or take the familiar way-bill. The New York Central lines last year purchased 7,000,000 way-bills at a cost of \$260,000. Total expenditures for stationery and printing for the year were \$1,900,000. A fair estimate of the portion of Class 1 Railroad earnings distributed annually among manufacturers of paper, pens, pencils, ink and other items which come under the head of stationery, and to printers, would be \$19,000,000.

"The railroads are good customers for the farmer, too. In dining cars are served annually approximately 8,000,000 pounds of beef. It takes a herd of more than 30,000 cattle to supply this beef, for only the choicest cuts are served in dining cars. Two million pounds of ham, 1,750,000 pounds of lamb chops, and 3,500,000 pounds of other meats, 3,250,000 pounds of butter, 6,000,000 quarts of milk, 27,000,000 eggs, 16,000,000 pounds of potatoes are among the items served annually in dining cars.

\$350,000,000 for One Year's Taxes

"I have gone into these details to give point and driving force to the great fact that money paid for transportation does not come to rest in a railroad treasury, but continues uninterruptedly on its beneficent mission, carrying its blessing to every farm and factory, to every nook and corner of this broad land. Upon the diminishing remainder of the railroad's dollar the tax-gatherer has fixed his hungry eye. Today he demands about six cents of every dollar taken in, or a total of \$350,000,000 for 1924. In eleven years, railroad taxes have increased 160 percent while dividends have decreased ten percent.

"We have now accounted for 85 cents of the railroad's dollar, leaving 15 cents which appears in statements as 'net railway operating income.' But do not make the mistake of thinking this represents the income of railroad owners. Since approximately 57 percent of railway capital is borrowed, there is a large sum to be paid in interest. This, with other charges, leaves to the railway owner an average of a little more than four and a half cents of each dollar. This is not sufficient to make railway stocks attractive to capital in competition with other forms of investment. What other industry can survive or has survived on such meagre return?

"To sum up, every one in all the land is vitally interested in the railroad in two distinct ways:

"First, as the transportation agency which moves 96 percent of all freight at rates so low that the farmer on the Pacific coast can afford to sell his produce to industrial workers on the Atlantic coast, while the latter can find a market for his wares in the most remote village of the far west.

"Second, everybody is interested in the railroads as purchasers of whatever they have to sell. Railroad revenues cover a multitude of purchases. If the railroads are prosperous they are able to buy freely, quickening the pulse of commerce and industry everywhere."

Where the Railroad Billions Go

PAY ROLL	\$ 3,000,000,000	48%
SOFT COAL	\$ 455,000,000	8%
MISCELLANEOUS	\$ 1,750,000,000	19%
ROLLING STOCK	\$ 1,150,000,000	14%
TAXES	\$ 350,000,000	6%
PROFIT	\$ 334,000,000	4%

RAILROAD
EMPLOYEESONE IN EVERY
25 WORKERS IS
ON PAY ROLL OF
THE RAILROADSALL WORKERS IN
THE UNITED STATES

219,000 IRON AND
STEEL WORKERS AND
THEIR FAMILIES ARE
INDIRECTLY SUPPORTED
BY THE RAILROADS

205,000 COAL MINERS
AND THEIR FAMILIES GET
THEIR SUPPORT FROM
THE RAILROADS.

127,000 LUMBERJACKS,
WOODWORKERS AND THEIR
FAMILIES ARE INDIRECTLY
SUPPORTED BY THE
RAILROADS.

70,000 EMPLOYED BY CAR
AND LOCOMOTIVE WORKS.

TOTAL NUMBER OF
WORKERS WHOLLY
SUPPORTED BY THE
RAILROADS—DIRECTLY
AND INDIRECTLY—621,000

WITH THEIR FAMILIES
THE TOTAL NUMBER IS
2,672,000

MORE THAN THE ENTIRE POPULATION
OF THE STATE OF WISCONSIN.

MISCELLANEOUS MATERIALS — STATIONERY, PINS,
INK, PENS, PRINTING, LINEN, FOOD, AUTOMOBILES, OIL, PAINT,
TRUCKS, TUG BOATS, ETC., TOTAL \$ 1,750,000,000 IN ONE YEAR

DINING CARS BUY FROM THE FARMER:—

8,000,000 LBS. BEEF	3,280,000 LBS. BUTTER
2,000,000 " HAM	16,000,000 " POTATOES
1,750,000 " CHOPS	27,000,000 EGGS
3,500,000 " OTHER MEATS	6,000,000 QTS. MILK

Your Railroad Fares Support Over Two and a Half Million People

The money paid to the railroads in fares and freight charges is about \$6,000,000,000 per year. A huge sum in very truth. Nevertheless, only a small fraction of this (about four and a half percent or less) goes into the

pockets of the shareholders. The money does not stay in the treasury of the railroads; for at once it begins to flow out into the industrial and commercial world, where it is expended in mining, steelmaking, lumbering, et cetera.



Lava Falls at the height of a September flood

Bridge to Span the Grand Canyon

By Far the Loftiest Structure Ever Planned to Cross from Wall to Wall of the World's Profoundest Gorge

By Lewis R. Freeman

THE recent introduction of a bill in Congress to provide for an appropriation to defray the cost of a suspension bridge across the upper gorge of the Grand Canyon of the Colorado marks the final step leading up to what will be one of the most daring engineering projects ever attempted.

Three hundred miles long, and many thousand feet deep for much of its course, the Grand Canyon of the Colorado River may well be ranked as the greatest natural obstacle to travel occurring in any settled and civilized region of the world. Indeed, only the oceans and the larger seas, with two or three of the major mountain ranges such as the Himalayas and Andes, constitute such formidable barriers to travel by land. But the navigable seas, in the last analysis, facilitate rather than hinder travel and transport, and most of the mountain ranges—even including the Andes—are crossed and recrossed by highways and railroads.

Grand Canyon Without a Bridge

The Grand Canyon, with the life currents of the growing giant of the American southwest surging round and about it, is unspanned by steel or by wagon-track. Just as the sheer walls of the great abyss turned back Cardenas, the discoverer, in 1540, and forced Father Escalante's *entrada* to avoid it by devious detour two centuries later, so did the westering currents of emigration divide and flow upon either side of it. And so right down into the present century, with progressive modern communities pressing closer upon it from every side, the Grand Canyon still remained an obstacle, a barrier.

The state of Arizona is divided by the jagged gorge of the Canyon into sundered divisions, united only by political ties. Towns of the respective sections, close enough together in a straight line to make semaphoring practicable from nearby mountain tops, are twice as far apart as New York and San Francisco by time of travel. The projected bridge and highway are planned to unite not only the dissevered divisions of Arizona but to make possible a new

and direct road through the heart of the southwest.

At the present time there are highway bridges across the Colorado River at Green River, Utah, and at Topock, ten miles below Needles, California. In the 700 miles intervening the only bridge is a light suspension structure at the mouth of Bright Angel Creek in the Grand Canyon National Park, and this is strong enough to permit the passage of but a single mule at a time. The only road crossing in the encanyoned section between Needles and Green River is the precarious ferry at the mouth of the Paria, immediately at the head of Marble Canyon—really the beginning of the Grand Canyon gorge. This

crossing is called Lee's Ferry, taking its name from the notorious Mormon renegade, John D. Lee, who was in that vicinity for many years after the Mountain Meadows Massacre of 1857, of which he was the chief instigator and for which he was subsequently executed.

The new highway is planned to follow considerable stretches of the primitive dirt roads now winding north and south from Lee's Ferry, but crossing the Colorado at the most favorable point in Marble Canyon (really the Grand Canyon) a few miles to the south.

No Near Rival for Height

The tentative bridge site at the present moment is at a point about four miles below the mouth of the Paria. Regarding this section of the river I find the following entry in the diary I kept during my recent voyage through the Grand Canyon with the United States Geological Survey party:

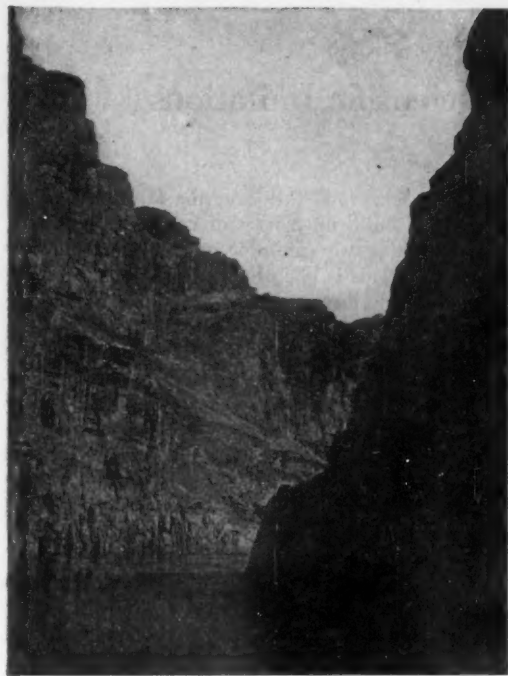
"The walls of Marble Canyon, which begins just below the Paria, rose rapidly as we proceeded, while the river fell away. The upper walls are limestone—dolomite—but a narrow strip of Supai sandstone soon began to show along the water-line. After running a splashy rapid we lunched about noon at a bridge-site located by the state engineers of Arizona. The section is a narrow one, with the walls close to 500 feet high. The bridge itself will have to be of very little, if any, greater length than its height above the water. If such a structure is built here it will have no near rival for height in any part of the world. And should the present survey disclose an equally favorable site any considerable distance down the canyon, that height might conceivably be doubled or trebled.

"The walls of the canyon are rising at an average rate of a hundred feet to the mile. Ten miles below the mouth of the Paria, for example, they should have a height of approximately a thousand feet; five miles farther along, fifteen hundred feet. Narrow sections at these points might well offer opportunities for throwing across the gorge a suspension bridge of a height hitherto undreamed of."



A POSSIBLE BRIDGE SITE

An overhanging wall would make it possible to throw across a bridge, suspended over 2,000 feet above the river, at this point



MARBLE CANYON

This is another view of the bridge site which is shown on the opposite page

The survey as it was continued found the canyon walls went on rising for a considerable distance almost exactly at the rate of a hundred feet to the mile. At Badger Creek the yellow rim of the Kaibab Limestone was 730 feet above the river; at Soap Creek it was an even thousand. At twenty miles from the head of the canyon the successive formations had reared to 2,000 feet. Here the Redwall Limestone came up to form an inner gorge, while the higher formations receded and towered as a secondary line of cliffs, with the opposing rims often half a mile apart.

The point where the inner gorge began to form, therefore, marked the extreme limit beyond which the most daring engineer could consider throwing a bridge from one plateau to the other. That is to say: the first twenty miles of the canyon, where the sheer walls form a single narrow gorge whose greatest depth is 2,000 feet, is the only section where the construction of a bridge would be feasible from either the standpoints of finance or engineering.

Since the late survey had to do with hydraulic

problems exclusively, detailed studies were made of dam-sites rather than bridge-sites. In taking the general contour, however, data will doubtless have been obtained that should be of much help in determining whether or not there are likely to be practicable bridge-sites at points below that already surveyed by the Arizona engineers. We passed through a number of sections above where the inner gorge began to form that were quite as narrow at water level as that at the surveyed site.

In no case that I recall, however, were the walls absolutely sheer, for which reason the interval to be bridged between the rims would be somewhat increased. At some of these points, even where the cliffs are over a thousand feet in height, it is almost certain that the building of a bridge is feasible from the engineering standpoint, leaving the factor of increased cost as the determining consideration. Since every mile (up to about fifteen or twenty) that the bridge were built down-river would mean a saving of two miles of distance in the road, as well as a hundred feet of ascent and descent, it would seem that the higher and longer structure might well be the more economical in the end.

Cost Comparatively Small

But even the construction of a bridge at the lowest point already surveyed would result in a structure far higher than anything of the kind at present in existence, or even likely to exist for many years. Record-breaker for height though it will be, there are not expected to be any new or unusual expedients of engineering involved. Indeed, the bridge will correspond very closely in type to the one now in use across the sheer-walled gorge of the Little Colorado at the Cameron trading post. Its estimated cost of \$200,000—half to be furnished by the Federal Government and half by Arizona—is comparatively small as the cost of most great bridges goes. In fact, the comparatively modest appropriation asked for is the main reason why one may expect preliminary construction to get under way this year.

It is to be hoped that, whatever type of bridge is adopted—suspension, arch, or cantilever—a due regard will be given to the artistic or scenic effect. The bridge should harmonize with its surroundings. For delicacy and grace of outline the suspension bridge will always find favor; whereas the arch, whether built in steel or concrete, conveys, to a

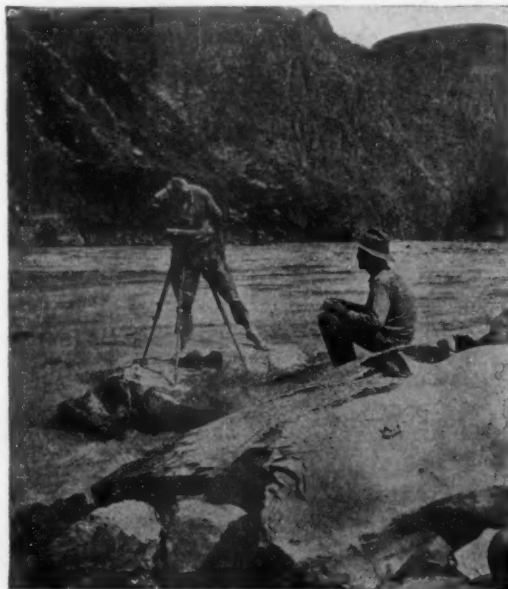


A LOFTY LOOK-OUT

A placid stretch of upper Grand Canyon. The tentative bridge-site is two miles below

greater degree than any other type, an impression of combined dignity, strength and permanence. In all probability, the question of type of bridge will be determined by the nature of the ground at the site selected. An arch bridge would call for abutments of the highest quality; preferably of solid rock. Probably a wire-cable suspension bridge would be found to present the easiest and cheapest solution.

The opening up of a new lateral uniting the now sundered state of Arizona is only the first and most obvious advantage of the projected bridge and highway. As a scenic route it will have few rivals anywhere in the world. A highway crossing the lofty Coconino Plateau from Flagstaff, the fantastic Painted Desert, the Grand Canyon itself, the splendidly forested Kaibab Plateau, and coming back to a transcontinental route again by way of Zion National Park is worth building for its scenic possibilities alone. That it is also economically warranted only clinches the certainty that it will soon become an accomplished fact.



ADVANCE WORK

Surveying the territory to locate the site of what will be the world's highest bridge



VISUALIZING THE BRIDGE

The plateau above the Grand Canyon at the site of the suspension bridge



GEOLOGY IN HOT WEATHER

The chief geologist of the Grand Canyon expedition testing the rock of the bridge-site

Buried Treasure

Apparatus for Locating Underground Minerals, and Pseudo-scientific Imitations

By Albert G. Ingalls

THE "doodle bug," a well-known mining journal calls it. It is an apparatus designed to locate underground minerals—gold, coal, oil—to find artesian wells, and to smell out buried treasure.

With this apparatus in your hands, all you need do is walk across the area suspected of concealing untold mineral wealth. Presently a delicate needle dips! A light flashes!! A bell rings!!! Mark the spot and dig, for you stand over your fortune.

Treasure trove! Shades of Long John Silver!

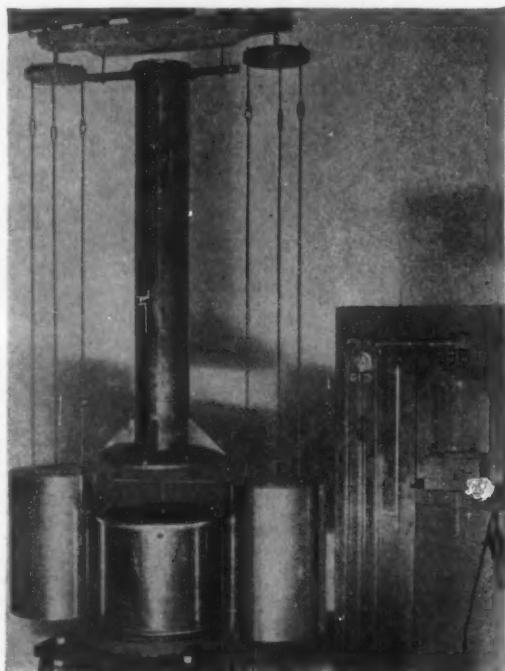
The Scientific American's morning mail brings many requests from people all over the world who have heard that there is an apparatus for locating mineral beneath the surface of the ground, and who want particulars of it. Some have heard even more, and want to know whether this or that type of ore-finding apparatus is scientific, or simply a hoax. They have been told of electrical methods of finding gold ore—and "electronic" methods; gravimetric methods—and "indicators"; magnetic methods—and dip needles for finding underground water streams; seismic methods—and plain hocus pocus.

What is the truth about all these things? Are they all a hoax?

Not all. There are several fairly well-established, truly scientific methods of prospecting without digging, and some of them are being quietly used at the present minute by the large oil and mining companies. Of such are the Eötvös torsion or gravity balance method, the electrical methods, the magnetic and the seismographic methods.

There are also numerous pseudo-scientific or even wholly non-scientific methods purporting to be useful for revealing the invisible.

I am told of an otherwise astute New York business man who for several months played with an alleged "scientific" gold-finding method, becoming involved with it and its inventor to the extent of



THE PROTOTYPE OF THE EÖTVÖS BALANCE
The torsion balance was originally devised by Cavendish, in 1798, for determining the earth's constant of gravitation

some \$20,000 before the fact finally dawned on him that the apparatus in question was a worthless and meaningless assemblage of wires, dials and pointers; and that the scientific terminology so impressively and freely babbled by its inventor was simply a jargon of individually correct, scientific long-words, strung together into sentences full of sound and fury, signifying nothing, like those used by the self-deluded Abrams electronic reactions practitioner. The repertoire of this type of "scientist" seldom omits such words as "electrons," "waves," "vibrations," "dynamic forces," and especially that invaluable stock-in-trade of the pseudo-scientific faker, the word "emanations." The changes that can be rung on these poor, overworked words seem endless.

Real Scientific Methods Exist

No device, apparatus, indicator, needle, or other patent dingbat for locating buried treasure exists. The best way to find treasure trove is to be good and lucky about the spot where you choose to dig for it. What really is needed is a machine that will read the mind of Captain Kidd's ghost.

Perhaps the knowledge that there are many pseudo-scientific methods which purport to find ore and oil has led some to believe that no real and scientific methods which work from the surface of the ground exist. This is far from the case; there are several such methods which have already proved valuable for finding concealed mineral.

It has been found that various rocks have differing degrees of electrical conductivities when dry, ranging from rock salt, with about 900,000,000,000,000 ohms per cubic meter, to galena (lead ore) with only .00003 ohm. Here is a leverage on which to pry in locating buried ore in suspected places.

Suppose we attach the respective ends of two wires to pointed electrodes which can be easily thrust into the ground a few inches in order to give contact. Keep them several hundred feet apart, turn on the current and take a reading of the potential. By

moving the electrodes all over the area it is plain that we can build up a map of equipotential lines, and from these we can plot any orebodies under the surface. This is one of several methods used by a Swedish-American company, and these methods have also been used by the inventors, Lundberg, Sundberg, Vos and Nathorst, to locate ore in Sweden for the Swedish Geological Survey.

Another of these methods is the inductive, in which a loop of wire is laid out on the surface. If an orebody exists underground, it should form with the loop a short-circuit transformer, and the secondary electromagnetic field of the orebody may be studied as an index of the situation of the body itself.

Professor Schlumberger of the Paris School of Mines, has used a patented method which employs the weak electric currents that naturally flow in many orebodies, due to electro-chemical reactions in them. In most cases these currents flow downward within the orebody and upward outside. They are detected and measured with a potentiometer used in connection with separate electrodes thrust into the soil at various points. Thus the orebody is charted. Mr. Sherwin F. Kelly of the Department of Geology of the University of Toronto, has been the sponsor for the Schlumberger method in this country.

In prospecting with the magnetic needle—another method—the technicians use magnetometers, very sensitive and delicate, and take advantage of the fact that in addition to the ferromagnetic rocks which are obviously magnetic (magnetite iron ore, "lodestone," for example) many other rocks have some slight magnetism. Others, like rock salt, are non-permeable.

Patents on an electromagnetic—sometimes called "radio"—method are owned by a certain college of mines in the southwest, Mr. D. G. Chilson of Los Angeles being the inventor (United States Patent Number 1,491,900). The director of this university requests us to suppress its name because of the hun-



WATER-WITCHING WITH THE DIVINING ROD

The Abbe Beuly, of France, noted for his ability to locate underground water, also uses the divining rod for locating buried shells on the battlefields of the World War. Water-witching, or "dowsing," is believed in by thousands, although no scientific explanation of its alleged efficacy can be given. Few subjects are so bitterly controversial



"RADIO EMANATOR" DISCOVERS GOLD!

So runs the caption of this German photograph, which is said to be that of a device which reveals the presence of gold, water or any other element under the earth's surface. "Acting on the theories of Hertz, Bohr and Planck," this apparatus is said to "feel out" the "atomic action" of the elements. It "does its work through radioactivity"



Courtesy of L. Oertling, Ltd., London

THE DELICATE EÖTVÖS TORSION BALANCE
So sensitive that it will detect the attraction of gravitation of a ton of coal at several yards distance

dreds of merely curious cranks who always write him letters following each mention of this sort. He adds that the method is useless on anything but the so-called "sulphide" ores, and in order to operate, it is necessary that such ore be exposed in place, either on the surface or in some mine. It cannot be told whether the ore is of high or low grade, or what metals are present in it. Like most of our category of methods, it has many limitations which throw it out of the "dead easy" class.

A great deal of general interest has been aroused over the use of the seismograph for oil prospecting, particularly in Oklahoma, and we have received many inquiries concerning the authenticity of this peculiar method. The seismograph is the instrument by which earthquakes are recorded. How can it be used to hunt for oil?

The seismograph does not locate oil. It may, however, be able to locate certain underground rock structures which are likely to contain oil. Such a structure is the salt dome, and another is the anticline.

In the Gulf Coastal region, most salt domes and anticlines are overlaid by a deep covering of de-

posits which mask them. How deep are the underlying rocks? Place a special seismograph at a given point, explode thirty to 300 pounds of dynamite within five or six miles and observe the record of the arriving shocks on the seismograph. The shock will travel at a given rate, generally quite slow, through the upper, looser deposits, but faster through the rock structure—if there is any—below.

From this record it is possible to deduce and calculate the depth of the overburden, and repeated tests may enable the technicians to outline the concealed salt dome or anticline. This method was originated by Dr. L. Mintrop, a German seismologist.

In 1887, Baron Eötvös, while professor of physics at Budapest, modified the torsion balance of Coulomb for the purely scientific purpose of investigating local variations in the earth's gravitational field. This instrument, again modified during the World War by the Germans who were hard up for oil, is now used quite extensively by the large oil companies for finding oil-bearing rocks.

"This Work Is Strictly Confidential"

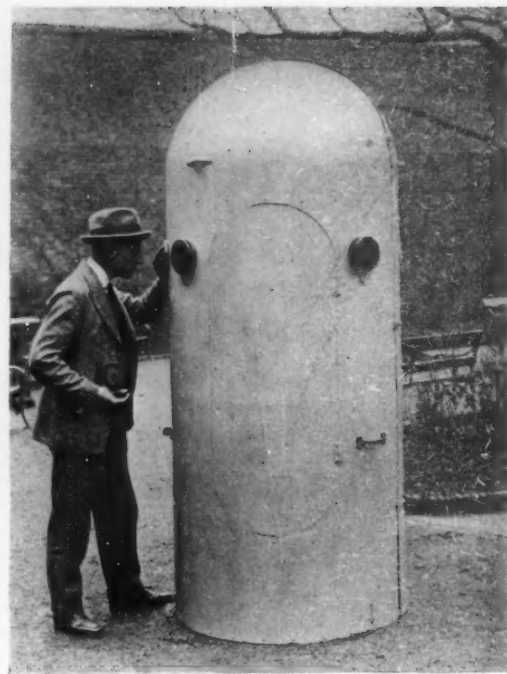
The attraction of gravity on the surface of the earth is virtually uniform everywhere. Certainly a pound of butter is a pound of butter in New York or in Kalamazoo—on ordinary scales. The Eötvös balance says no; the butter changes weight slightly. If the earth's rocks were homogeneous, and if the equator did not bulge, the attraction of gravity would doubtless be absolutely uniform everywhere. But the earth's crust is not homogeneous. Different kinds of rock have differing densities. Mountain masses exert their gravitational influence laterally, and even a wagonload of dirt has its own attractive force of gravitation which the highly sensitive Eötvös balance will detect at several yards.

This impressively delicate instrument consists of an aluminum balance arm about two feet long, suspended at its center by a torsion wire.

Two small, equal weights are attached to the respective ends of this bar, at different heights. The success of the instrument depends on the difference between the gravitational forces acting on these two weights, due to their different distances from the attracting body (see cut).

These parts of the balance are highly insulated from heat changes by three thicknesses of metal; and the whole instrument has a triple cover.

It is set up on the ground to be explored and is left alone until the balance comes to rest. This takes one hour! To explain the technical details of its operation would require a technical article by itself.



Courtesy of L. Oertling, Ltd., London

THE TENT THAT COVERS THE EÖTVÖS BALANCE
Through the telescope in the triple-shelled, heat-insulating walls, the observer is watching the balance swing

Three readings are taken at each spot, and two spots may be covered daily.

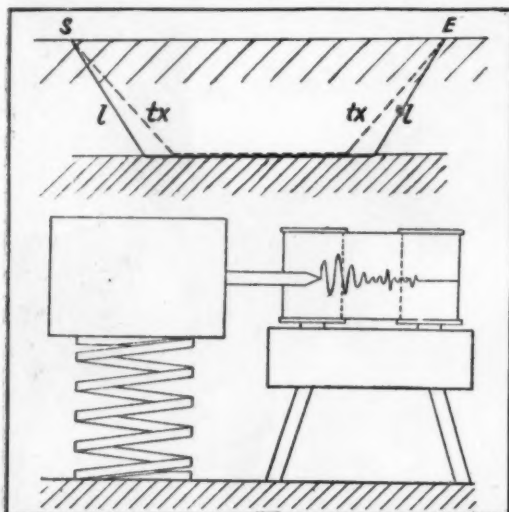
The staff consists of two especially trained technician-geologists, and several untrained assistants. The balance is so sensitive that even a man's approach affects it, due to his attraction of gravity!

Salt domes are of lighter density than ordinary strata and thus they may be found and demarcated with the Eötvös balance. The same is true of coal. Anticlines, many of which contain oil, are usually abnormally dense.

Several of the very large oil companies now use these balances, but they do not shout it from the housetops. First, to do so brings in swarms of letters from cranks with bright ideas; and, second, they have developed the technique for their own use.

The chief geologist of an Oklahoma oil company thus replied to my inquiry: "I beg to state that this work is strictly confidential and nothing whatever can be stated by me regarding it. Our attitude is that the less published about geophysical methods, the better pleased we are."

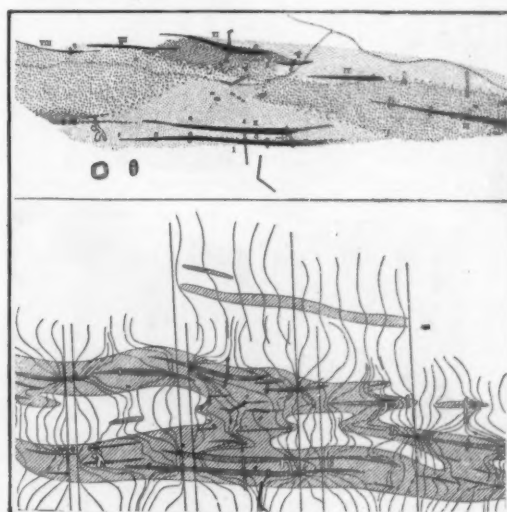
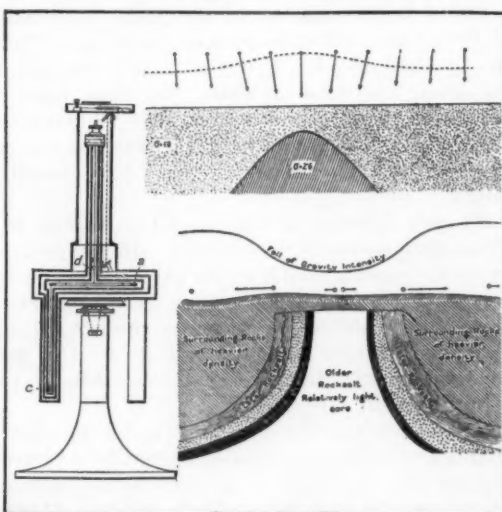
And there you are!



Courtesy of "Das Technische Blatt"; "La Nature"; "Economic Geology"; "The Mining Magazine"; "The Swedish Geological Survey"

DETAILS OF THREE OF THE SEVERAL METHODS OF LOCATING MINERALS FROM THE SURFACE OF THE GROUND

LEFT: The seismographic method. Dynamite explosion at E, seismograph at S. The wave *l*, traveling through the lower, denser stratum, outdistances the wave, *tx*. Thus, two waves arrive, and this helps locate the stratum sought. The seismograph is shown below. CENTER: The triple-walled Eötvös balance, cross-sectioned. Note balance arm inside, with weights *a* and *c* attached; also tiny mirror, *d*. The upper cut shows how a denser underground stratum attracts the balance abnormally; while the salt dome in the lower cut is unusually low in density. Oil may accompany such salt domes. RIGHT: Showing by comparison how the Swedish electrical methods revealed iron ore bodies under several feet of soil. The map below was made electrically, and the one above shows what digging later revealed. Note the equi-potential lines





Chinchilla trappers in the Peruvian Andes, 16,000 feet above the sea. Chinchillas are caught alive, in wire traps, but there are so few animals left that trapping barely pays

Naturalizing the Chinchilla

The Valuable, Fur-bearing Rodent, Almost Extinct in His Native Andes Mountains, Is Being Colonized Now in California

By John L. Von Blon

JUST as the chinchilla was about to become extinct in South America, where it lives wild, a few specimens of these soft, fuzzy little animals have been captured, brought to California and are now slowly being acclimated to their new environment.

Two years ago an American journeyed to South America, penetrated to the lofty heights of the Andes Mountains of Chile and Peru, and captured twelve chinchillas. He took these animals to the seacoast, put them aboard ship at Iquique, Chile, brought them across the tropics at great pains, and established them in the hills of Southern California where

they are thriving and increasing in numbers at a fairly rapid rate.

Since a pair of baby chinchillas kept six years should normally produce 126 pairs, the owner of this herd estimates that he will have 3,000 of the little fur bearers by 1931. At present he will sell none at any price, figuring that the potential future supply of this precious fur is now here, and that before long the world will have to look to the United States for it.

Therefore, the chinchilla, which furnishes one of the most beautiful furs in the world, is not doomed to extinction, after all, for its probable acclimation in California may result in chinchilla wraps becoming once more available for people not blessed with extreme wealth.

Packed in Ice

Chinchillas are natives of the Andes Mountains of Peru, Chile, and the neighboring countries. They live at high altitudes, 12,000 to 18,000 feet above sea level. At these altitudes they have become acclimated, and, therefore, when they are brought to lower altitudes they usually die. For this reason efforts to colonize them elsewhere have usually failed.

Recently, however, a resident of Los Angeles determined to overcome this difficulty. He planned to go to the natural habitat of the chinchilla, capture a number of these animals alive and bring them down to low altitude by stages, accustoming them to lower and lower altitudes until the level of the sea was reached. Then he would bring them on to North America.

Eight years ago this man went to Chile, where, after many trying experiences, he finally captured a dozen good specimens of the chinchilla. For two whole years he kept these animals at about 11,000 feet, a somewhat lower elevation than that in which he had captured them, giving them the best of care during this time.

Next, he brought them down to 8,000 feet altitude, where he maintained them for one more year. By a

series of such stages he eventually reached the coast.

Finally, from Iquique, Chile, the owner of the herd of chinchillas took the animals by steamer to Los Angeles, a forty-day voyage of eight thousand miles. To bring these creatures across the torrid tropics was a problem. They do not enjoy heat. In fact, it is extremely trying to them. Yet, if chinchillas were to be re-colonized in North America, the tropics must be crossed—there was no getting around that.

For this contingency a special cage was constructed. It held in its center an ice compartment, holding 100 pounds of that heat-absorbing substance. Outside, it was curtained with canvas which was



THE CAGE WHICH HAD TO BE KEPT ICED

To keep the chinchillas alive while the steamer crossed the tropics, they were kept in this special, iced cage



HIGH UP IN THE CHILEAN ANDES

The owner of the California chinchilla herd, on the hunt for the thirty-two animals which he brought back

1895 the skins were worth 25 cents
 U.S. dollars



"OUR NEW HOUSE IN CALIFORNIA"

Concrete boxes like little ovens are used to house the chinchillas. These boxes, set partly under ground, afford the necessary coolness and quiet for the sensitive animals



WHAT A CHINCHILLA LOOKS LIKE

The chinchilla is nine inches long. It has large, rounded ears, long hind legs, a bushy tail, and beautifully fine pearly-gray pelage, which is in great demand in the fur trade

kept moist, so that evaporation would help in keeping the interior of the cage cool.

Passing through the tropics the chinchillas had literally to be packed in ice. Even then they frequently became overheated, when they would drop to the floor of the cage and stretch out as if dead.

They displayed remarkable stamina, however, and always responded to treatment and revived. Four days from Southern California, they shed all their fur and they had to be wrapped in blankets in order to prevent them from freezing. Constant attention was necessary. The entire lot got through nicely, although later one died on account of old age. They were landed under permit of the United States Biological Survey, the chief of that bureau writing that it was the first and only importation of chinchillas to the United States, and therefore was of unusual interest.

Through intensive study during those initial years the owner became familiar with the habits of his pets—for such they soon became—and became fond of them; and in a short time he made them as much at home in their new surroundings as the family cat and dog, and apparently as contented.

Herd Worth Almost a Million Dollars

They are housed in well ventilated, screened buildings divided into pens six feet by twelve feet in dimensions. These pens in turn contain oven-shaped concrete boxes twelve by eighteen inches in size, inside measurement. The retreats are placed partly underground, thus affording coolness, quiet and protection from fire. In them the little nocturnal mammals spend their days, coming out only to sun themselves. As security against theft—for the chinchillas are considered priceless and could not be replaced—the "dens" are heavily padlocked. Three-quarters of a million dollars would not buy the herd, for there are no others outside of South America and none are known to be in captivity anywhere else.

Inasmuch as three chinchillas consume no more

food than one chicken, it does not cost much to keep them. They like anything in the way of vegetables, grains, nuts and fruits, uncooked or dried, even preferring their new diet to the deer grass and bush roots on which they subsisted in their South American habitat. They are dainty, cleanly and odorless, friendly and playful. Often they sit on their haunches and beg for tidbits. Their intelligence is about equal to that of the gray squirrel, like which they bark. They also croon and coo when happy.

They have bodies much like squirrels, though more plump, and heads like cottontail rabbits. These burrowing, hopping rodents are a little less

than one foot long, with tails seven to eight inches in length. Nature produces nothing more exquisite than their fur. This pelt, after removal, is about twelve by eight inches.

In the Andes Mountains of South America the foxes are mainly responsible for the decimation of the chinchilla, although the native trappers have done much to exterminate them. Indeed, in their native environment their days are numbered. So scarce have they become that the trappers may work for weeks without a catch. Less than thirty years ago the market price of skins was twenty-five cents each, but now they bring \$100 or more, and even at that price they are virtually unobtainable.

Cold Absolutely Essential

The chinchilla requires a long, dry, sunny season for breeding; this it has in the Andes Mountains, where the snowy winters last but four months. It bears two litters of young annually, and the period of gestation is 111 days. Usually the litters consist of twins, but they range from one to as high as four. Soon after birth the young are able to take care of themselves. At the age of twenty-four hours they are so lively that it is almost impossible to take indoor photographs of them.

The fur of the chinchilla cannot take on its best qualities without a cold season, and for that reason the California herd will be removed to the San Bernardino Mountains of that state or to the Grand Canyon region of Arizona, where elevation, extreme and mean temperatures, and climatic conditions generally are considered ideal for these rodents.

The single specimen shown in the accompanying illustration is six years old and is one of the beauties of the California herd. He was captured when but two weeks old and was brought up and spoon-fed in the Chilean Andes. A cat slept with him and kept him warm until the chinchilla became mischievous and nipped the tom's paws and tail. This broke up the friendship!

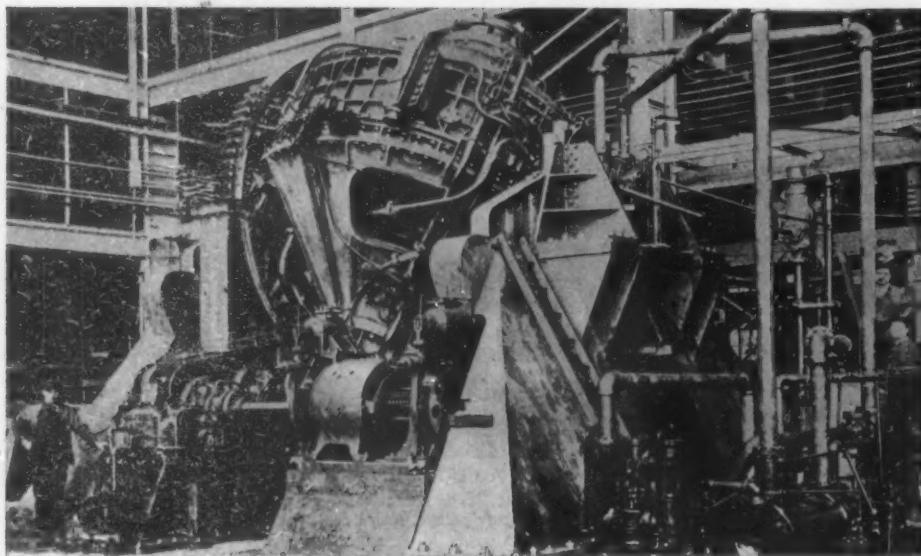


Courtesy of H. Jaeschel & Sons

THE COSTLIEST CHINCHILLA WRAP IN THE WORLD

Chinchilla is perhaps the most beautiful, although the most perishable of peltries. Many hundreds of the precious little skins went into the making of this rare and striking garment

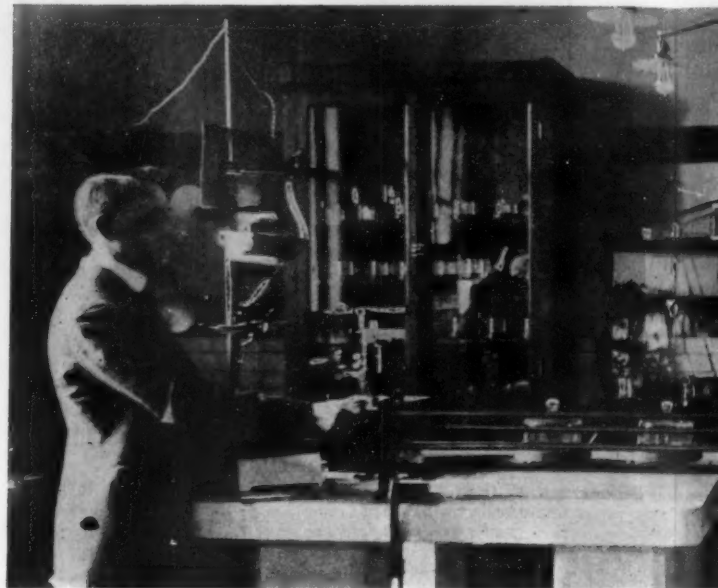
From the Scrap-book of Science—Can



Wide World

TO BANISH SEA SICKNESS

A mammoth gyro stabilizer to be installed in a 20,000-ton American liner. The gyroscope is a big, heavy metal disc, revolving at a high rate of speed and such a revolving disc offers great resistance to lateral motion. This quality enables the steamer actually to steady itself by holding on the gyroscope, which stubbornly refuses to swing



Wide World

HOW STANDARD WEIGHTS

This is the way they compare standard weights at the Bureau of Standards, Washington. A body would cause an error if he stood close to them. Therefore, he stands



U. S. Department of Agriculture

CROP REPORTERS WAITING FOR THE SIGNAL OF RELEASE

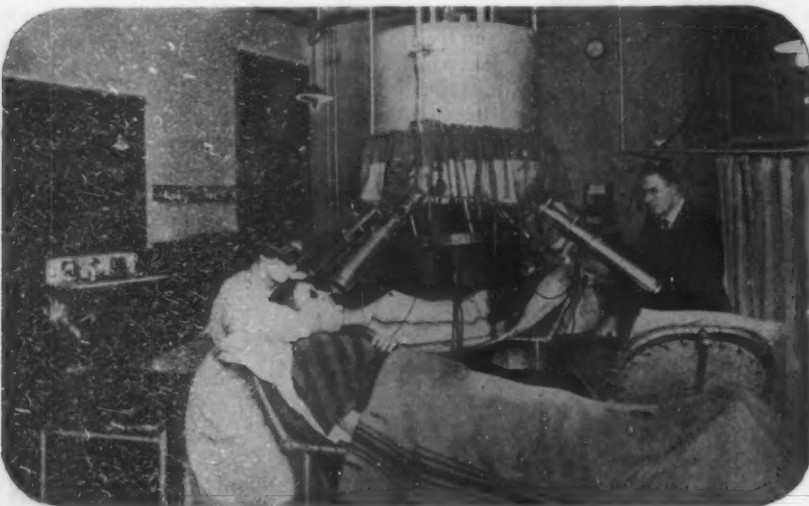
The Agricultural Department issues at periodic intervals forecasts of the crops in different parts of the United States. Reporters from newspapers and magazine services who wish to get them are permitted to come early and rush away with the copies at the instant of the release hour



Wide World

NEW GAS MASKS DEVELOPED BY UNCLE SAM

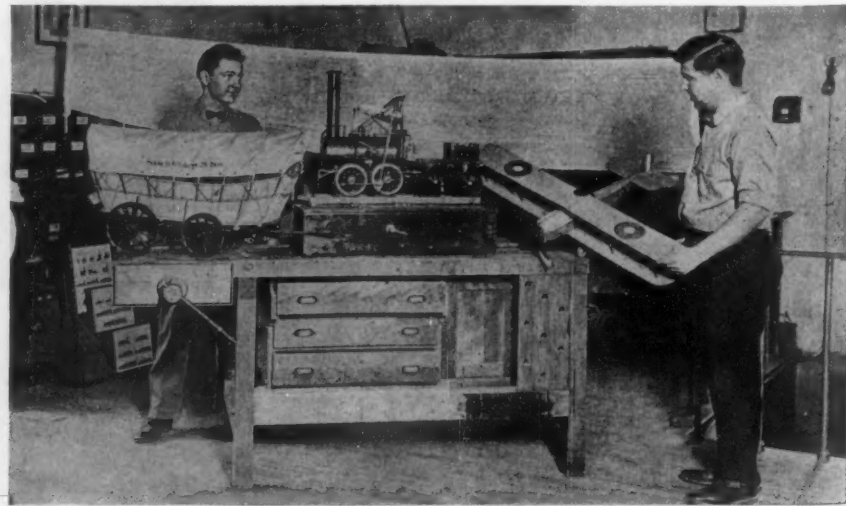
Far superior to the old types are these new masks, designed for various industries and shown at the recent Exposition of the Chemical Industries. The army masks are made of leather, have no nose-clip to pinch the wearer and the eye-pieces will not cloud with moisture



General Photographic Agency, London

AN ULTRA-VIOLET RAY TREATMENT

Professor Nils Finzen, of Copenhagen, Denmark, first used the ultra-violet rays of the sun's light in the treatment of skin diseases, notably of lupus. The lenses are of quartz

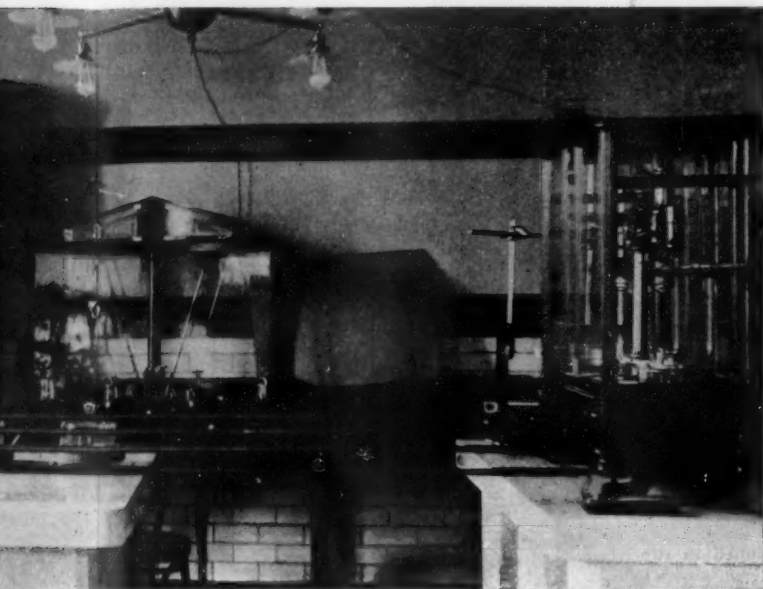


Wide World

TRANSPORTATION, PAST AND PRESENT

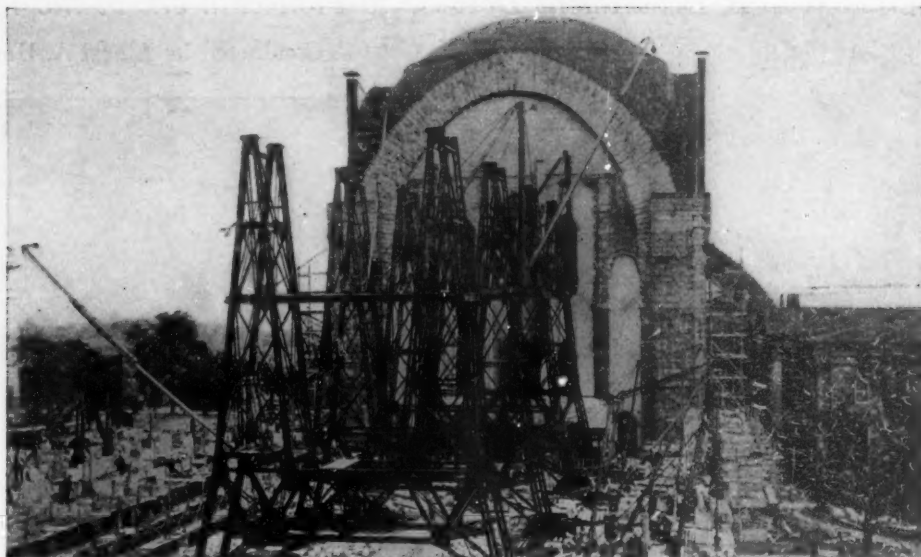
An exhibit is being prepared at the Smithsonian Institute showing the progress of transportation. Walter A. Roth, left, and Fred Reed, curators, are shown preparing the exhibit

-Camera Shots of Scientific Happenings



BOARD WEIGHTS ARE COMPARED

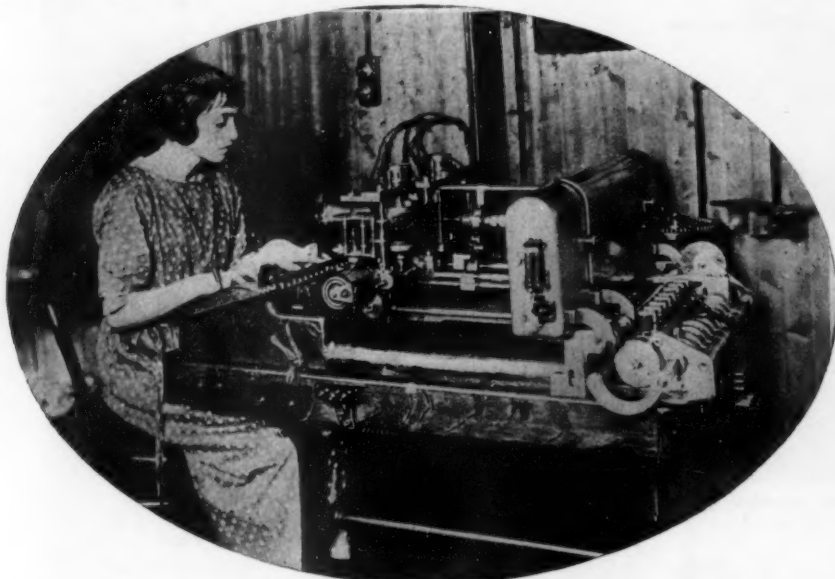
standards, Washington, D. C. The balances are so sensitive that the heat of the operator's hand, therefore, he stands on the other side of the room and operates them with long rods



Wide World

THE MODERN METHOD OF BUILDING CATHEDRALS

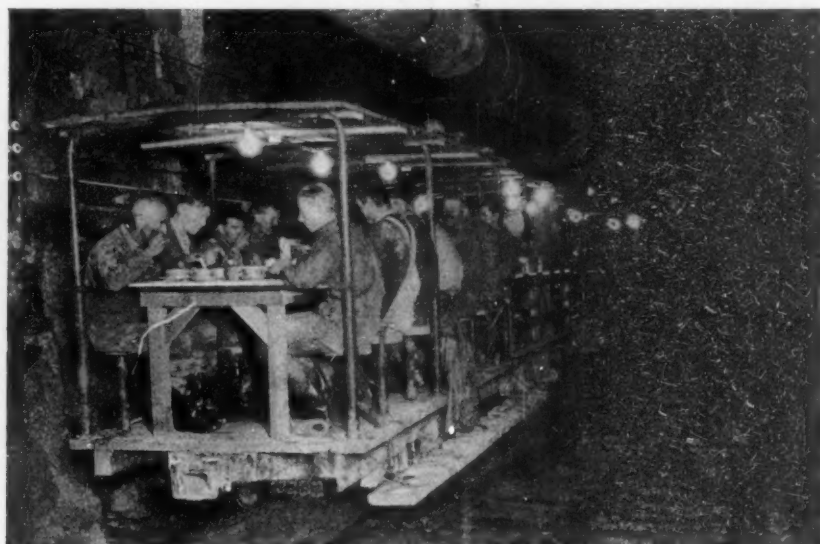
Three pairs of steel towers, 84 feet high, support derricks which lift the granite and limestone blocks for the walls and pillars at the Cathedral of St. John the Divine. The framework is temporary. A platform will rest atop the towers and from this will run the wooden centering to support the arches until each keystone is in place



Wide World

WILL CAMERA PROCESS ABOLISH METAL TYPE?

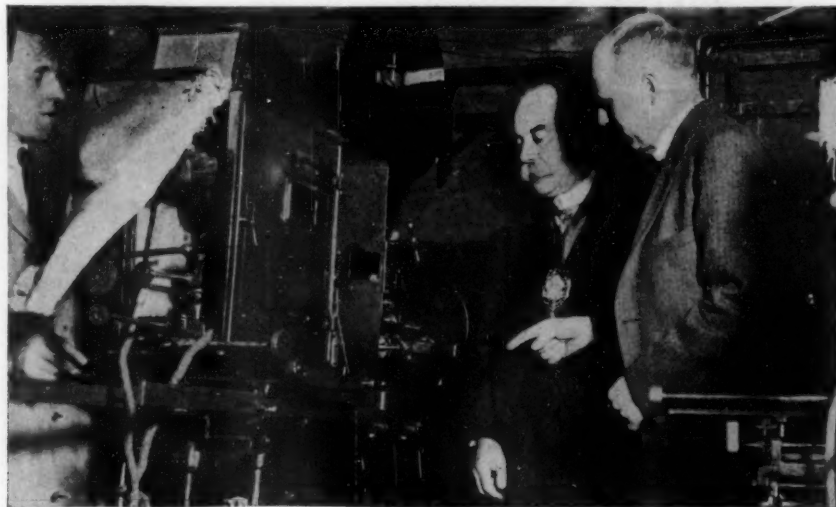
The basis of this invention is a film on which letters, figures and all kinds of type have been photographed. By a keyboard, like a typewriter, characters from the "master film" are projected in rapid sequence on a sensitized base and photographed by fractional exposures



Wide World

AN UNDERGROUND DINING CAR

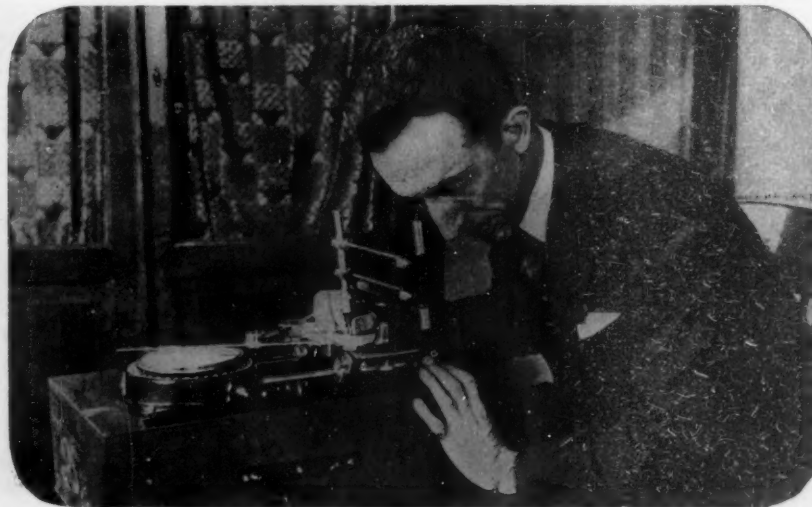
The Florence Lake Tunnel which is being drilled by the Southern California Edison Company is fifteen feet square and over thirteen miles long. A force of laborers is kept at work day and night. To save time, the workers have their lunch served in this dining car



General Photographic Agency, London-Wide World

NEW FILM INVENTION GIVES STEREOSCOPIC EFFECT

A new invention for adaption to a film projector creates a stereoscopic effect on the screen. Besides giving the impression of distance and a fuller projection, it eliminates eye strain



© Times Wide World

COMMANDER LE PRIEUR AND HIS NAVIGRAPH

The invention keeps airplanes on their course in side winds. If a wind is blowing transversely, to follow the desired course it is necessary to head the machine, more or less, into the wind

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Various Arts and to Patent News

Conducted by Albert A. Hopkins



An air pistol from Germany

Some Imported Air Pistols

FOR a long time we have looked in vain in this country for a good air pistol; and at last we have found two—one made in England and the other in Germany. The English article is trimmer in appearance and is almost identical with the well-designed military automatics in general conformation. The barrel is hinged near the muzzle end and the pistol is cocked by lifting the



An English air pistol

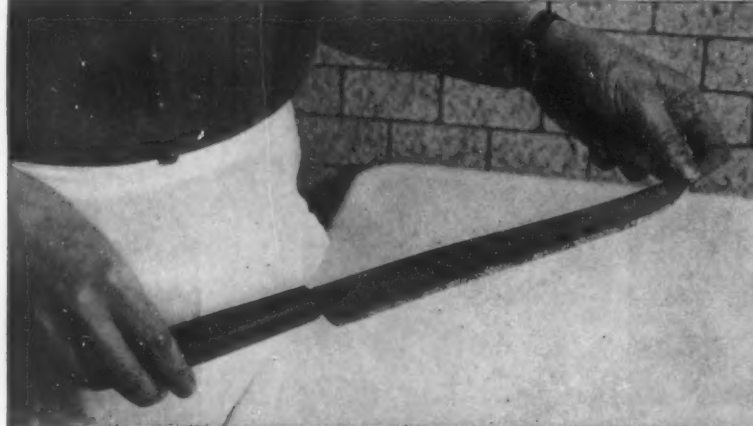
barrel upward and thus compressing the piston. Considerable force has to be exerted against the short leverage supplied by the barrel. The German air pistol is very much longer and our illustration shows the method of charging by compressing the air with the lever.

Armature and Field Coil Taping Machine

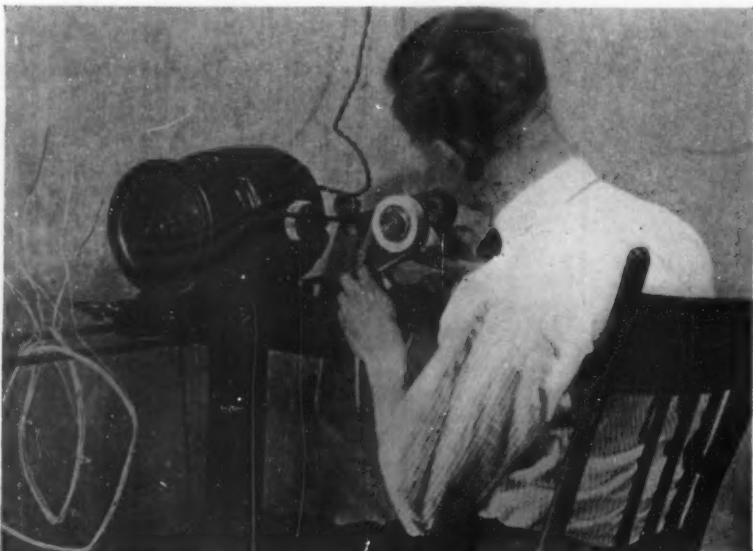
THIS machine consists of the armature or field coil taping-machine head, directly belted to a very slow speed motor on which is mounted a cone clutch. Responding to pressure on a treadle, this clutch gives instantaneous and very fine adjustments in speed. The continually moving member of the clutch is pinned to the armature shaft, which has enough end-play to allow the clutch to be disengaged. It is returned to open position by the action of the motor, thus eliminating a thrust bearing and a spring. A combined self-oiling cone driving pulley, brake pulley, and clutch member rides on an extension of the motor housing.



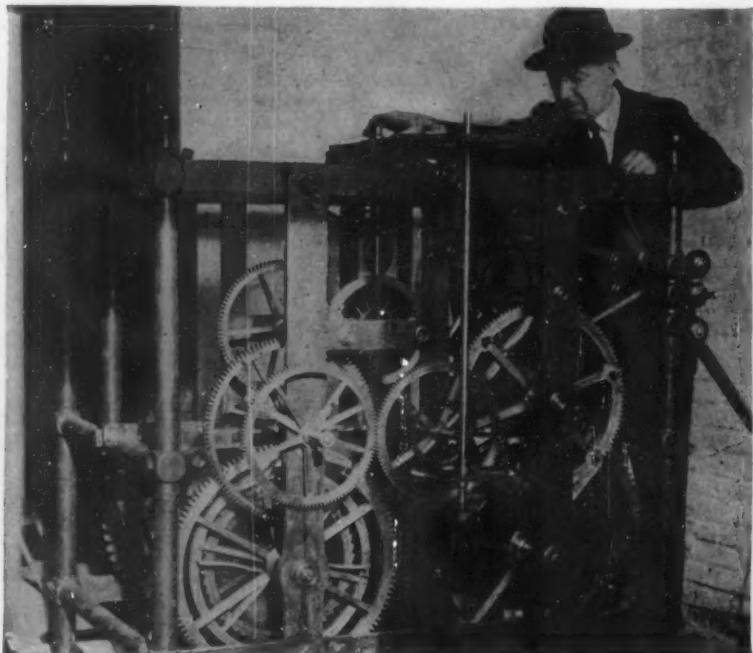
A folding safety razor



An extraordinarily efficient bread knife. Instead of being scalloped in the old-fashioned way, the blade of this knife is serrated



Armature taping machine. The clutch of this machine gives instantaneous and very fine adjustments in speed



The old historic clock of Independence Hall, now at Germantown, keeps perfect time



How the air is compressed

It is active only when engaged, thus eliminating troublesome "loose pulley" bearings. A three-step cone pulley provides a suitable range of speeds.

A Safety Razor That Folds Up for the Pocket

THIS safety razor has no long handle; and it folds up into a flat package. The two handles which the fingers grasp fold toward one another and the shaving equipment will go into the vest pocket. The



Charging the pistol

finger grips are close to the cutting edge and a better control for the shaver is said to be possible. A neat little carrying case of leather is provided.

A Historic Clock

THE old clock once in Independence Hall, Philadelphia, is hardly "a new invention"; but it is worth printing here as showing the remarkable precision of the work of our ancestors.

A Flexible Sanding Pad

A SANDING tool that takes curved and plain surfaces alike is compressed snugly into curves, as in moulding. It fits the hand comfortably, keeps the fingers away from injury and affords a firm gripping action. It accommodates a large piece of sandpaper at a time, thus preventing waste. The sheet of sandpaper is removed by simply sliding forward at center. Corrugated rubber is mounted on a piece of curved metal and the sandpaper placed upon this. Its edges fit under the metal form without other fastening. It is indispensable around the shop, home and factory.



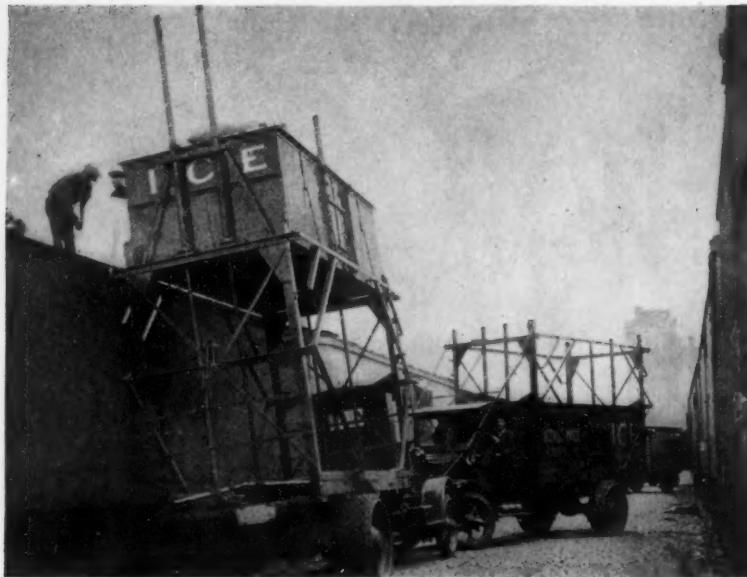
A mobile sanding tool



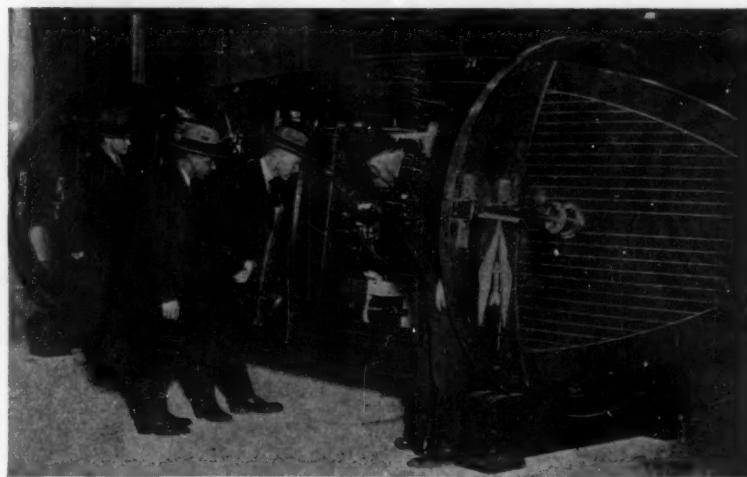
An electric cross in neon gas

An Electric Cross

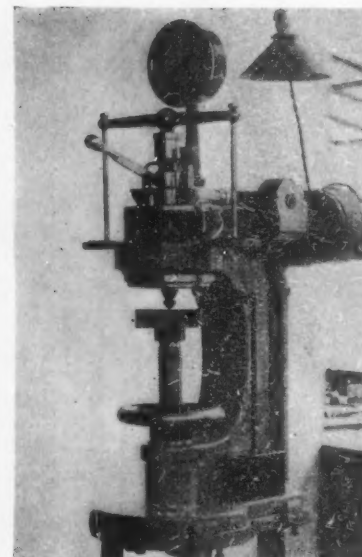
THIS lamp consists of two cross-shaped metal electrodes inside a symmetrically blown, tipless, glass bulb filled with neon gas. When either alternating current or direct current is switched on, an electrical discharge takes place which is visible as a luminous haze. The cross with its mild orange-hued light thus appears as a self-luminous body. All the bulbs burn on both sides when alternating current is used; on direct current the bulbs burn on one side only, either negative or positive. Either side may be made to burn at will by simply changing the poles. A small spring at the bottom of the bulb enables it to be placed facing in any direction without breaking the contact. The life of the bulb is about three thousand hours and because it is a two- to three-watt bulb, it never becomes heated. It costs only about one cent for forty hours' use.



A new and speedy way of icing the refrigerator car. The body of this truck, containing ice, is elevated so that it is on a level with the top of the car to which the ice is to be transferred



A revolving sales device for the motor boat



Making Brinell hardness tests with the aid of power

Icing the Refrigerator Car

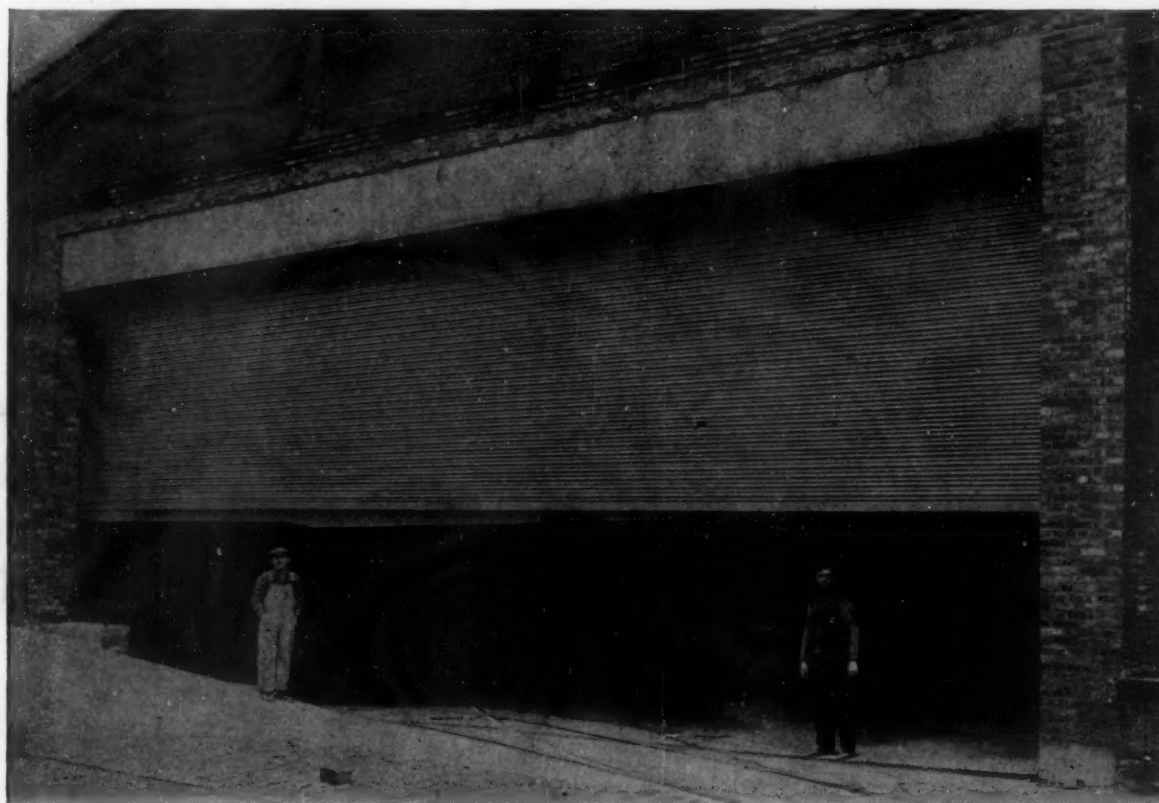
A NEWLY devised elevated ice body for motor trucks, used in icing railroad refrigerator cars, has greatly simplified that operation. Under the old system of icing, where flat-bodied trucks were used, three men placed two tons of ice in refrigerator compartments of a single car in thirty-five minutes. The new elevating body requires the services of two men and does the same work in eight minutes, thus effecting a saving of twenty-seven minutes.

Power-operated Brinell Tester

THIS is a motor-driven testing machine to determine the hardness of steel, iron and other metals. The essential features are the same as in the hand-operated machine.

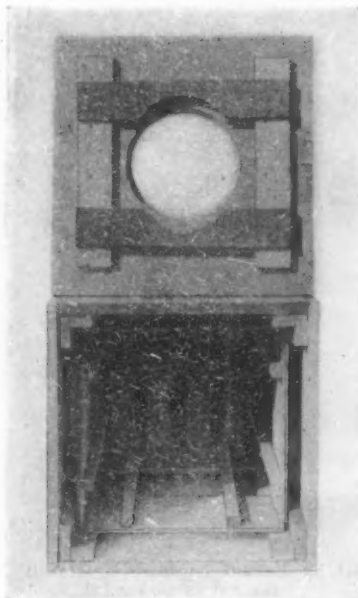
Displaying the Motor Boat

AT a recent motor boat show a Detroit manufacturer exhibited his boat in a novel way. It was held in a metal frame which rotated so as to show every part of the boat. This is an ideal method.



Largest rolling door ever built. It is forty-five feet wide, seventeen feet high and is operated by an electric motor





Carboy box and cover

Safe Transportation of Acids

EVERY little while we hear about the breaking of a carboy or an acid bottle, producing disastrous results. We show on this page a carboy box for the shipment of all kinds of liquids, including inflammable or corrosive acids. This box meets all the Interstate Commerce Commission's requirements. The interior fittings are removable and interchangeable and do not have any hay, mineral wool or other protective packing which would absorb moisture and thus increase shipping weight.

The box is very simple to pack, as it only requires to have the bottle inserted and the lid nailed down. One of our illustrations shows an ingenious method of testing the carboy and its container. The box is drawn away and is allowed to hit the buffer, thus giving a much more severe test than when it is in actual use.

Upholstering Spring Brace for Raising Sagging Chair Seats

UNINSIGHTLY, uncomfortable, sagging seats are not only saved, but made as pleasing looking and as comfortable as when new with the device illustrated. It consists of two springs and six fasteners. Anyone who can drive a nail can apply the braces.

Cutting Test Specimens from Roadways

IT is often desirable to secure test specimens from roadways. This is easily accomplished with the aid of the device shown. The machine, with gasoline engine and water tank, is usually mounted on a three-ton truck and consists of a three-inch, four-inch, or six-inch pipe attached to a revolving shaft. This revolving pipe is lowered to the surface of the pavement. Small steel shot and water are fed through the center of the pipe, thence under the edge of the pipe, thus furnishing an abrasive by which the pipe



The harness in use

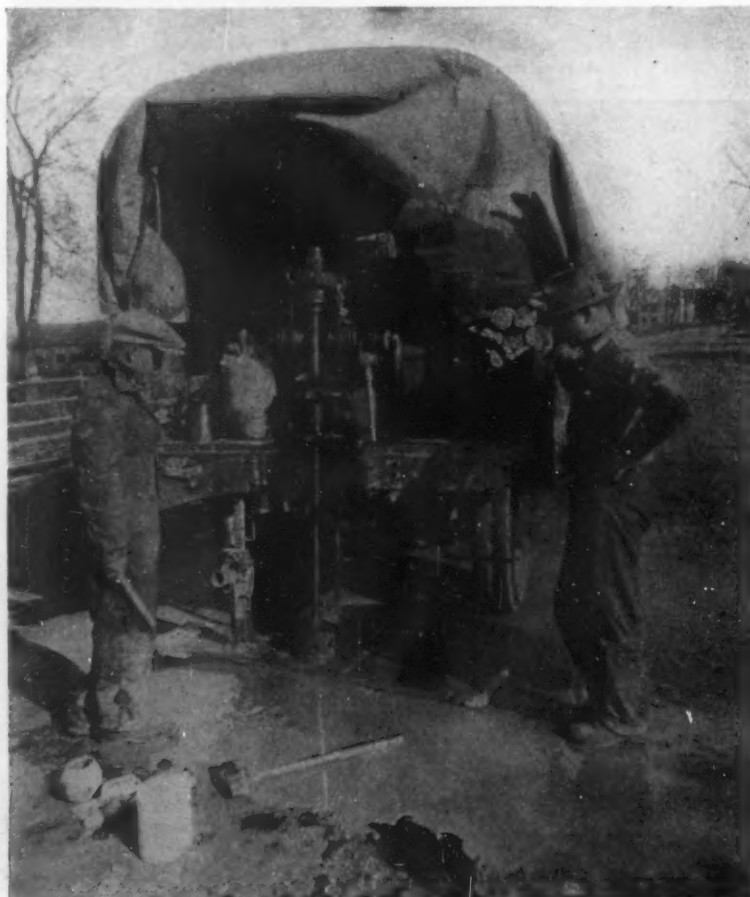


Giving the carboy and its container an artificial jolt

gradually eats its way into the pavement surface, cutting a circular-shaped hole. When the pipe has been thus forced through the pavement the entire apparatus is raised and the test specimen, commonly called a core, is removed from the inside of the pipe.

Such specimens are used for the purpose of determining the depth, density, and general appearance of the pavement and may also be prepared and tested to determine the compressive strength of the pavement at that point.

This device has been used very successfully by the State Highway Commission of New Jersey and the information was obtained from the State Highway Engineer. Photo by Ewing Galloway.



Obtaining samples of roadway



Salvaging a sunken chair seat

A Stephenson Anecdote

JUST about one hundred years ago Stephenson was trying to obtain the consent of the House of Commons of Great Britain to the building of a railroad line. In presenting his petition to Parliament, he had some difficulty in restraining his enthusiasm, and among other statements, he said that on this railroad he would pull trains with an engine of his design that was capable of running at twenty miles an hour, says *Machinery*. His counsel finally informed him that if he did not moderate his statement about being able to run his engine twenty miles an hour, "and bring it within reasonable speed," he would spoil his chances of obtaining the required permission from Parliament. At the same time, Parliament was urged by outsiders to limit the speed of the newly invented steam engines.

How Prof. Moore Ventilates His Home

PROF. WILLIS H. MOORE, formerly Chief of the United States Weather Bureau, has introduced in his house at Pasadena, Calif., an interesting method of ventilation which keeps the house supplied with fresh air cooled and given the right degree of humidity. Two funnels are placed on the roof. One is arranged so that it always faces the wind. The other, which carries off the foul air, is turned away from the wind. Just below the intake funnel is a box-like affair containing the water through which the air is forced.

The Child on the Front Seat

THE device which we illustrate is intended to hold a child firmly on the front seat of an automobile so that the attention of the adult can be given exclusively to driving the car.

A leather harness is fitted around the shoulders, waist and back, serving to keep the little passenger firmly on the seat, but it is not so confining as to make the wearer uncomfortable. It prevents him from bouncing off the seat when going over uneven parts of the road. The harness is secured to the seat by buckles. The child's hands and feet are free at all times.



A detail of the harness

Recently Patented Inventions

Classified Advertising

Advertisements in this section listed under proper classifications, rate 25c per word each insertion; minimum number of words per insertion 24, maximum 60. Payments must accompany each insertion.

Official copies of any patents listed in this section at 15c each; state patent number to insure receipt of desired patent copy.

Chemical Processes

PROCESS AND APPARATUS FOR RECOVERING COPPER FROM ITS OXIDIZED OR ROASTED ORE.—Consisting in treating the ore with a leaching solution which contains sulphate of iron, and subjecting the solution to the action of sulphur dioxide gas and air. Patent 1550521. J. B. Du Faur, Turramurra, New South Wales, Australia.

LEPTINOL AND PROCESS FOR MAKING THE SAME.—By treating the roots of leptotaenia dissecta with alcohol, removing the gum, and saponifying the resins and oils of the alcoholic extract. Patent 1551888. E. T. Krebs, c/o The Balsamea Co., 2590 Folsom St., San Francisco, Cal.

Electrical Devices

ELECTRIC-CONDUCTOR COUPLING.—A two part coupling especially adapted for use in connection with radio sets, unusable except with parts of special design. Patent 1552262. C. F. Betz, 1285 St. Mark's Ave., Brooklyn, N. Y.

ELECTRIC GAUGE FOR GASOLINE TANKS.—Wherein the circuit is normally open but may be manually closed and will indicate the amount of gasoline in the tank. Patent 1552373. B. F. Winterhoff, cor. Elkhart and Jackson Bldgs., Elkhart, Ind.

ELECTRIC-LIGHT FIXTURE.—Which will produce a soft subdued and shadowless light, evenly distributed throughout the room. Patent 1552066. V. Le Beau, c/o C. I. Denckand, Atty., 406 Hibernia Bank Bldg., New Orleans, La.

ELECTRIC COUPLING.—Connecting and disconnecting with facility, yet insuring a positive establishment of the circuit. Patent 1552346. W. A. Riley, New York, N. Y.

CRYSTAL DETECTOR.—Readily assembled and disassembled for inspection or repair, and by means of which the variations in sensitivity are avoided. Patent 1551845. E. L. Popper, 1242 Madison Ave., New York, N. Y.

ANTENNA SPREADER.—For radio antennae, on which the antenna wires can be arranged in any desired combination yet very firmly fastened. Patent 1553244. C. F. Jacobs, 279 Park Place, Brooklyn, N. Y.

TELEPHONE AMPLIFIER.—Providing a vacuum relay wherein the sound waves of a receiver are amplified with greater distinctness, for long distance telephony. Patent 1552776. L. A. Tilden and C. Knudson, Rexford, Kan.

STORAGE BATTERY.—Of the electrolytic type, having means whereby the voltage of each cell of the battery may be indicated at a remote point. Patent 1553742. O. R. Blatter, Albion, Neb.

SEAT SIGNAL.—To be used by ushers in theatres for indicating to patrons in the rear of the house the number of available seats. Patent 1554469. V. W. Thomson, 826 Third St., Portsmouth, Ohio.

VACUUM-TUBE FILAMENT FUSE.—For use with radio vacuum tubes, in which the fuse forms part of an adapter for receiving the standard radio vacuum tube. Patent 1554499. W. Healey and M. J. Roquier, c/o C. E. Jack, 220 Washington St., Waukegan, Ill.

Of Interest to Farmers

METHOD AND APPARATUS FOR CURING HAY, ALFALFA AND THE LIKE.—Which will insure a thorough ventilation and a proper curing of the material, during the process of stacking. Patent 1549138. R. E. Maudlin, 383 Ninth St., San Francisco, Calif.

CHICKEN NEST AND ROOST.—In which the roosts are disposed over the nests, both nests and roosts being easily kept in a sanitary condition. Patent 1551479. H. H. Fuller, Berlin, Wis.

SUBSOILING ATTACHMENT FOR DISK GANG PLOWS.—Constructed to properly function for stirring the earth beneath the plows

News for Inventors

A Department of Facts and Notes of Interest to Patentees and to Owners of Patent and Trademark Rights

Conducted by Milton Wright

America's Great Inventors

AMERICA'S greatness is due to her inventors, we are told. Yes, but what are the great inventions? To answer the question the Patent Office has prepared a list of what it considers basic and important patents; it has been sent to the Scientific American by Mr. William I. Wyman, Chief Examiner. Note in Mr. Wyman's list, which we publish herewith, that the Wright Brothers are credited with the invention of the airplane, wherein the Patent Office differs with the Smithsonian Institution, which gives the credit to Langley.

INVENTION	PATENTEE	DATE
AGRICULTURAL		
Cotton Gin	Whitney	1794
Reaper	McCormick ..	1834
RAILROAD		
Air Brake—original ..	Westinghouse ..	1869
Air Brake—automatic ..	Westinghouse ..	1872
Car Coupler — auto-		
matic	Janney	1873
ELECTRICAL		
Telegraph	Morse	1840
Telephony		
Telephone	Bell	1876
Berliner Transmitter ..	Berliner	1880
Longdistance (Pupin) ..	Pupin	1900
Automatic	Strowger	1892
Lifting Magnet	Eastwood	1905
Gyroscopic Compass ..	Sperry	1918
ELECTRO-CHEMISTRY		
Aluminum Production ..	Hall	1889
Carborundum	Acheson	1896
RADIO		
Tube Detector	De Forest	1906
Grid	De Forest	1908
Wave Production	Fessenden	1904
Crystal Detector	Dunwoody	1906
Regenerative Circuit ..	Armstrong	1914
Electric Starter, Auto ..	Coleman	1903
Multi-Control for Elec-		
tric Trains	Sprague	1900
ELECTRIC LIGHTING		
Arc	Brush	1879
Carbon Filament	Edison	1880
Tungsten Filament	Coolidge	1913
Mercury Vapor	Hewitt	1912
MISCELLANEOUS		
Electric Train Signal ..		
ing	Robinson	1872
Induction Motor	Tesla	1888
Fume Arrester	Cottrell	1908
Electric Welding	Thomson	1886
DOMESTIC		
Vacuum Cleaner	McGaffey	1869
Electric Flat Iron	Seely	1882
Safety Razor	Gillette	1904
WARFARE		
Revolver	Colt	1836
Machine Gun	Gatling	1862
Submarine	Holland	1902
LABOR-SAVING DEVICES		
Sewing Machine	Howe	1846
Typewriter	Sholes, Glid-	
den, etc.		1868
Cash Register	Ritty & Birch ..	1883
Linotype	Mergenthaler ..	1890
Monotype	Lanston	1896
Stereotyping, Automatic ..	Wood	1903
High Speed Steel Tools ..	Taylor & White ..	1901
Button Hole Machines ..	Reece	1881
GLASS MAKING		
Glass Shaping Mach. ..	Owens	1904
Sheet	Colburn &	
Washburn		1908
Cylinder	Lubbers	1902

IRON AND STEEL		
Open Hearth Charger..Wellman	1890	
Blast Furnace Charger.Brown	1885	
SHOE MACHINERY		
McKay & Stitcher....McKay & Mathies	1862	
Goodyear Welt	Goodyear 1871	
Pulling Over Machine.McFeely	1900	
PHONOGRAPH		
Edison's OriginalEdison	1878	
Wax Record	Bell & Tainter 1886	
Lateral Cut	Berliner	1887
MOTION PICTURES		
Kinetoscope	Edison	1893
Camera	Edison	1897
Projection	Jenkins	1895
CONSTRUCTION		
Barbed Wire	Glidden	1874
Expanded Metal	Golding	1884
Reinforced Concrete Beams	Hyatt	1878
MISCELLANEOUS		
Airplane	Wright Bros..	1906
Half-Tone Process	Ives	1893
CHEMICAL SUBSTANCES		
Vulcanized Rubber	Goodyear	1860
Celluloid	Hyatt	1870
Vaseline	Chesebrough .	1872
Bakelite	Baekeland	1909
STEAM ENGINEERING		
Corliss Valve Gear....Corliss	1849	
Curtis Steam Turbine.Curtis	1896	

"Official" Golf Balls

SUPPOSE you bought a golf ball marked: OFFICIAL GOLF BALL.

This ball is standard and official as required by the U. S. G. A., the Royal & Ancient Club and other governing bodies.

Would you think it had been specifically indorsed by the two governing organizations?

You probably would think so, says the Federal Trade Commission. As a matter of fact, the ball never was officially adopted, wherefore the Commission rules that the Allied Golf Company, a Chicago corporation, is misbranding and mislabeling its balls under circumstances which constitute unfair competition, and orders that the practice be ended.

"Rubber" Roofing

A RECENT decision of the Federal Trade Commission, finding the Barrett Company guilty of unfair competition, brings to light a curious twist of advertising. The company was representing that its well-known roofing contained rubber, when, as a matter of fact, not only was there no rubber in it, but the Prepared Roofing Association five years ago adopted a resolution declaring: "Rubber deteriorates on exposure to the weather, as is known to everyone, and to represent that the roofing contained rubber would not only be untrue, but would also injure the reputation of the roofing."

The Barrett product is a composition felt-base roofing material. It has been advertised as Everlastic "Rubber" Roofing and its thickness has been designated by the terms one-ply, two-ply and three-ply, although in no case was it made in layers. The use of both "rubber" and "ply" are banned by the Commission's decision.

substantially at the same time that the plows function. Patent 1551477. D. T. Fleming, Lahaina, Maui, Territory of Hawaii.

FARM IMPLEMENT.—For disintegrating the soil, combining the features of a clod crusher, soil mixer and soil surfacer. Patent 1552362. J. Versteeg, 100 E. 11th St., Portland, Ore.

SHEAF SHOCKER.—For attachment to any reaper and binder, forming a predetermined number of sheaves into a shock and automatically setting the bundle on the ground. Patent 1553216. W. M. Clark, Granville, N. D.

SACK.—Adapted to be manipulated conveniently without causing chafing of the body of the user in cotton picking. Patent 1553241. W. B. Hickey, R. R. No. 1, Box 175, Sapulpa, Okla.

CLEANING ATTACHMENT FOR CORN-PLANTER RUNNERS.—Which may be operated while the implement is in operation for cleaning the runners in a thorough manner. Patent 1554110. E. Martens, Pomeroy, Iowa.

CHICKEN COOP.—Designed for the protection of small chicks, for sheltering them from the force of wind or rain, irrespective of its direction. Patent 1553544. J. F. Lunemann, Estelline, S. D.

ATTACHMENT FOR CORN CULTIVATORS.—Having means for replacing the usual blades, whereby the cultivator is adapted to break and turn the soil more effectively. Patent 1553685. W. B. Gresham, R. R. No. 1, Atlanta, Ill.

POTATO-HOLDING RECEPTACLE.—For holding potatoes in a definite position conveniently at hand to a person cutting up potatoes for seeding purposes. Patent 1554071. L. L. Downs, 147 Sound Ave., Riverhead, L. I., N. Y.

Of General Interest

MONEY BELT.—"Bandit Proof Money Belt" for payroll clerks and bank messengers. Transfers money to and from a bank much safer. Belt cannot be cut off, neither can contents be cut out. Patent 1536965. Benjamin Ocker, Marion, Pa.

SAFETY CHAIN CLASP.—Intended for use with necklaces, and the like, in which one of the cooperating members must first be compressed before disengagement. Patent 1548274. J. F. Mitchell, c/o Milwaukee Optical Mfg. Co., Milwaukee, Wis.

PANE-CONNECTING MEANS.—For connecting and sealing the meeting edges of glass panes such as employed in show windows and show cases. Patent 1548707. L. H. Broome, 33 Greenwood Ave., Jersey City, N. J.

CARBOY.—With lateral supporting members having shoulder blocks for supporting the bottle, the supports being replaceable. Patent 1549578. C. Lefkowitz, c/o National Box & Lumber Co., 350 South St., Newark, N. J.

CLOTHESLINE SUPPORT.—In which an arm is provided, swingable from the window into the room, for conveniently hanging the clothes. Patent 1549512. M. J. Shanley, 612 56th St., Brooklyn, N. Y.

WATER BAG.—Forming a receptacle which may be positioned over the foot, or feet, to give the desired temperature. Patent 1549510. B. Schnitzler, 111 W. 23rd St., New York, N. Y.

CARBOY.—With an inner skeleton frame, which is removable from the body, thus convenient to repair. Patent 1549577. C. Lefkowitz, c/o National Box & Lumber Co., 350 South St., Newark, N. J.

CHICKEN ROOST.—In which a fumigating preparation will be contained beneath the roost, that the fumes will rise among the roosting birds. Patent 1549280. E. Wolam, 718 No. Broadway, Decatur, Ill.

FLUX FOR SOLDERING.—Comprising tallow and olive oil, the composition is of particular

utility in the soldering of aluminum. Patent 1549573. L. Ciaffone, 205 Ave. N, Brooklyn, N. Y.

STERILIZING DEVICE.—Whereby gases formed as the result of heating the liquid may conveniently escape, and a check on the temperature is maintained. Patent 1548899. S. Oyama, c/o Harry Irwin, Hilo, Territory of Hawaii.

GARMENT HANGER.—Formed of sections, which may be packed in a minimum space, and quickly assembled for supporting garments. Patent 1550634. A. Polkko, Box 153, 529 Clinton St., Brooklyn, N. Y.

MAIL BOX AND LETTER-CARRIER'S POUCH.—Arranged to operate in conjunction with each other, so that the pouch may be filled, locked, and collected, without the mail being touched. Patent 1550597. L. Viezzi, 845 Anderson Ave., North Bergen, N. J.

ANCHORING SHANK FOR BATHROOM FIXTURES.—Constituting means to be inserted in a recess in the bathroom wall and maintained in place by a cementitious substance. Patent 1550485. J. H. Balmer, 259 Plane St., Newark, N. J.

CYLINDRICAL CASE FOR HOLDING SHAVING SOAP AND SIMILAR OBJECTS.—Comprising an inner and outer case, the inner having a plurality of slits forming resilient tongues for holding a soap-stick. Patent 1550613. G. A. Hundewadt, c/o W. Massohn, 99 Linden Strasse, Berlin, S.W. 68, Germany.

POCKETBOOK.—With an arrangement of fastening device which prevent accidental opening, and will be neat and durable. Patent 1550576. A. Schnuerer, 15 E. 32nd St., New York, N. Y.

REVOLVING DUPLEX TICKET CABINET.—Whereby four independent sets of tickets may be conveniently dispensed. Patent 1550630. O. S. Payzant, Room 2615, Grand Central Station, New York, N. Y.

CAP FOR PENS.—Which may be retracted upwardly on the barrel of a fountain pen, to expose the nib, without entirely removing the cap. Patent 1550599. S. Walker, 215 Montague St., Brooklyn, N. Y.

TOILET ACCESSORY.—Which constitutes a wall attachment and combines an ash tray, cigar or cigarette holder, match holder and newspaper holder. Patent 1550486. J. H. Balmer, 259 Plane St., Newark, N. J.

GLYCERINE SOAP AND PROCESS OF MAKING SAME.—Comprising coconut oil, caustic soda lye, and glycerine, the glycerine being from 50 to 90 per cent of the volume. Patent 1550540. W. T. Gussinklo, 437 49th St., Brooklyn, N. Y.

ADJUSTABLE CHAIR LEG.—Which may be used on one or more legs, say two or four of a table or chair on an uneven surface. Patent 1549144. H. L. Messegue, Seattle, Wash.

COMBINED SOAP-BUBBLE DEVICE AND HUMIDIFIER.—For furnishing the required amount of water vapor to the air in a room, or to form bubbles for display. Patent 1550057. E. B. Beeler, 2915 S. Wabash Ave., Chicago, Ill.

COMPRESSION FLUSH TANK.—Which eliminates the use of a ball valve, and requires less water for the flushing operation. Patent 1549846. J. N. Murphy, 500 Forrest Ave., Springfield, Ill.

CUSHION SEAT.—Provided on its under surface with means for defining a plurality of air pockets, giving a cushioning effect. Patent 1551452. M. F. Arias, 149 Elm St., Newark, N. J.

CONNECTING LINK.—For attaching the extremities of jewelry, chains, beads, necklaces or the like, to the clasp elements. Patent 1551446. F. B. Wendel, c/o Hercules Novelty Co., 126 South St., Newark, N. J.

GLASS-PANE-COUPING DEVICE.—Providing an attractive means for securing panes of glass located at an angle to each other. Patent 1551462. L. H. Broome, 33 Glenwood Ave., Jersey City, N. J.

DRAIN FOR REFRIGERATORS.—In which the drain pan and pipe are so constructed that they may be readily cleaned without removing the contents of the box. Patent 1550809. W. L. Hummel, 2911 N. Richmond St., Chicago, Ill.

BUILDING CONSTRUCTION.—By means of which a cement wall is produced, utilizing pre-cast posts and run-in-place walls between the posts. Patent 1551469. W. P. Cummings, 25 Eighteenth Ave., Long Island City, N. Y.

OPTICAL INSTRUMENT.—A compact unitary and portable structure, adapted to be employed as a diagnostic instrument in the

examination of eyes. Patent 1550941. C. A. Bahn, 722 Audubon Bldg., New Orleans, La.

CLASP.—Designed for use in connection with belts, garters, or articles of a similar nature. Patent 1551455. H. Barnowitz, 1036 DeKalb Ave., Brooklyn, N. Y.

Hardware and Tools

ROTARY DRILL BIT.—Of the so-called fish-tail type of construction, for use in drilling wells or like operations. Patent 1552724. R. O. Moore, Box 243, Wewoka, Okla.

SCISSORS SHARPENER.—Which insures the proper relation of the blades to the sharpening element, and may be successfully operated by unskilled persons. Patent 1553276. J. R. Watts, c/o J. Watts Co., Lambert Works, Lambert St., Sheffield, England.

PERMUTATION LOCK.—In which the use of dials are dispensed with, whereby the lock may be readily manipulated at night or in dark places. Patent 1553251. W. Lindeke, 510 Ave. F, College Point, L. I., N. Y.

GRINDING TOOL.—Especially adapted for use in resurfacing the contact points of the timer of internal combustion engine ignition circuits. Patent 1554117. G. W. Moore, R. F. D. No. 8, Norwichtown, Conn.

FAUCET.—Of the self-closing type, having means by which it may be releasably held partially open to provide for a continuous stream. Patent 1553447. J. M. Jackson, c/o Rope and Cordage Co., Union Trust Bldg., Parkersburg, W. Va.

MEANS FOR OPERATING HANDSAWS.—By which the operator can use the saw a long time without feeling the strain caused by the constantly vibrating handle. Patent 1554096. C. Jensen, 1736 N. Fairfield Ave., Chicago, Ill.

CASING TONGS.—Capable of uniformly and effectively gripping a casing with a jaw tensioned just sufficient for the purpose. Patent 1554677. R. L. Johnson and F. R. Jones, Sulphur Mines, La.

Machines and Mechanical Devices

DEVICE FOR CONTROLLING THE FLOW OF WELLS.—For controlling the direction of flow of gushers from oil or gas wells, by means of a manually operated valve. Patent 1543637. J. M. Woll, Kittanning, Pa.

EMBROIDERY MACHINE.—Having a gear driving mechanism whereby different patterns may be produced, and an accurate number of stitches provided in each pattern. Patent 1551453. M. Aronson and W. Baumgart, 1335 Intervale Ave., Bronx, N. Y.

PUMP.—For the purpose of keeping pressure on the oil in an oil line, so that the necessary flow may be kept up. Patent 1550931. C. F. W. Tabler, Apdo 1164, Tampico, Mexico.

BISCUIT-IMPRINTING MACHINE.—For printing a considerable number of biscuits with an adapted design at one time. Patent 1551088. M. Collis, 165 King St., Charleston, S. C.

MOTION PICTURE CABINET.—So constructed as to permit of the convenient operation of the device without assuming a strained position. Patent 1551259. A. G. Merriman, 1487 Central Ave., Memphis, Tenn.

CONSTRUCTION FOR GAS PRODUCERS.—Whereby the purge cap of a gas-producing furnace is carried by a truck which will not be warped or thrown out of register. Patent 1551422. E. Nelson, 306 W. 20th St., New York, N. Y.

VARIABLE INTERMITTENT WEB FEED.—Provided with means for feeding and cutting any desired length of fabric from the fabric body. Patent 1549540. T. Hawthorne, Box 64, Charlotte, N. C.

REMOVABLE WARP-BEAM HEAD.—Whereby the beam may ordinarily function in the usual manner, and whenever desired may be removed for storage or shipment. Patent 1549604. E. C. Neu, c/o Schwarzenbach Huber Co., Oak St., West Hoboken, N. J.

WASHING MACHINE.—Wherein the clothes may be thoroughly washed, rinsed with clear water, "blued," and wrung out, without the necessity of handling. Patent 1552378. W. A. Austin, 121 No. Lincoln Ave., Scranton, Pa.

WIRE-SHAPING APPARATUS.—Which may be manually operated to accurately bend wire, tape or other metal strip into any desired shape. Patent 1552367. V. J. Watral, 30 Lexington Ave., Maspeth, N. Y.

INK-VENDING DEVICE.—Adapted to eject the desired amount of ink for the filling of

a fountain pen at each operation. Patent 1551667. D. N. Jerauld, 2592 Kingston Rd., Cleveland Heights, Ohio.

WOOD-CARVING MACHINE.—Having a spindle carrying frame that will not contract or expand when subjected to various temperatures. Patent 1551861. W. B. Young, 902 No. La Salle St., Chicago, Ill.

CANDY MACHINE.—That will slice a roll of candy into disks, or "lolly-pops," and provide each disk with a stick. Patent 1550070. J. L. Goss, Howard and Beale Sts., San Francisco, Cal.

GRADE CLEANER.—Adapted for use in combination with grading implements for highways commonly known as sub-graders. Patent 1550048. A. J. Clausen, 1550 Lake St., San Francisco, Cal.

SAW SHARPENING MACHINE.—Including abrasive means which operate not only to sharpen the teeth, but to automatically feed the saw through the machine. Patent 1550-913. C. S. Marsh, 1755 W. Adams St., Los Angeles, Cal.

MILKING MACHINE.—Having an automatic "pulsator" whereby the various parts of the machine may be connected with a vacuum, or air pipe. Patent 1552538. B. Brayshaw, c/o General Tool and Manufacturing Co., 383 4th St., Milwaukee, Wis.

OSCILLATORY DRIVE FOR LATHE HEADS.—Which may be employed as an attachment to the ordinary type of lathe for cutting arcuate bores and apertures as well as surfaces. Patent 1552727. J. P. Oeschger, 1244 N. La Salle St., Chicago, Ill.

FLUID AND LIQUID PROPELLER AND MOTOR.—In which a blade functions in coaction with a crank movement in a manner designed to bring about an efficient motive action. Patent 1553177. M. Kulmer, c/o Paget, Moeller & Hardy, Riemergasse 6, Vienna 1, Austria.

HEDGE TRIMMING MACHINE.—Which is portable, may be held for operation at any desired angle, and will cut the width over which it is moved. Patent 1552858. J. Lipovac, c/o Hugh Seales, Florist, 409 No. 19th St., Birmingham, Ala.

TILE PRESS.—Wherein power means is provided, and an automatically actuated brake for stopping the moving parts on the return stroke. Patent 1553243. W. H. Ivens, P. O. Box 647, Trenton, N. J.

PROCESS AND DEVICE FOR RECORDING SET-UP LINES ON MACHINES FOR CASTING AND SETTING MOVABLE TYPE.—Effecting the recording and casting on the same machine and by the same person so that a saving of labor is realized. Patent 1553190. F. Schimmel, c/o C. Chassevent, 11 Boulevard de Magenta, Paris, France.

WATCH.—In which the hands are set and the spring wound by a longitudinal reciprocation imparted to a plunger connected to a knob. Patent 1553192. K. and M. Shaya, 1634 Bathgate Ave., Bronx, N. Y.

Pertaining to Vehicles

WOASTER.—In which the front and rear wheels may be swung in either direction, a spring returning them to their normal position. Patent 1548973. E. B. Beeler, 2915 S. Wabash Ave., Chicago, Ill.

VEHICLE DRIVE.—With optional forms of suspension, which will allow for the adaptation of the drive to any desirable type of vehicle. Patent 1549534. W. R. Graham, c/o F. C. Reilly, 1457 Broadway, New York, N. Y.

COMBINED DUST CAP AND AIR SEAL FOR TIRE-VALVE STEMS.—Which when in applied position on a tire valve stem will be held in place securely although releasably. Patent 1550566. G. W. Oakes, Crystal City, Mo.

TRAILER COUPLER.—With means for connecting the tractor engine to the coupling mechanism for raising the trailer when uncoupling the same. Patent 1550555. W. Mayer, 55 Meserole Ave., Brooklyn, N. Y.

POWER TAKE-OFF.—By means of which the rear wheel of an automobile may be used to drive a grinding wheel, circular saw, or similar device. Patent 1550111. P. F. Siewert, Brant, Mich.

RESILIENT GUARD FENCE.—Adapted to be erected along the sides of a dangerous road to prevent vehicles going over the edge. Patent 1549139. R. E. Maudlin, 383 Ninth St., San Francisco, Calif.

WINDSHIELD FOR MOTOR VEHICLES.—Which will permit the passage of air in predetermined quantities, but will effectively prevent the entrance of rain or snow. Pat-

ent 1550818. R. H. Kerlin, 530 Clark St., Chicago, Ill.

WHEEL PULLER.—Which will quickly pull a wheel from the axle of an automobile without danger of distorting the parts. Patent 1550802. F. Hampton and J. P. Umhoefer, R. F. D. No. 2, Cleghorn, Iowa.

ROAD LAMP.—Which will illuminate the side of the road indicating to the driver how far he is from the edge thereof. Patent 1551720. P. C. Williamson, 819 Oak St., Winnetka, Ill.

BRAKING DEVICE FOR VEHICLES.—Which will automatically prevent the drive shaft from being rotated by the rear wheels when an ascending automobile is stalled on a hill. Patent 1551570. A. I. Kaplon, c/o V. Kaplon Co., Brunswick, Md.

HEADLIGHT.—With which by manual manipulation the light can be varied and the glare reduced to a minimum. Patent 1553246. T. O. D. Jansen, c/o Pery G. Cooke, Colombo, Ceylon.

ACCELERATOR-CONTROL DEVICE.—Which may be applied to various standard types of automobiles for releasably maintaining the accelerator in various adjusted positions. Patent 1553280. C. B. Wright, 2787 Boulevard, Jersey City, N. J.

COIL BOX.—Especially adapted for Ford cars, so constructed that the various coils may be easily applied and removed at any time. Patent 1553255. J. W. Mertz, Avant, Okla.

WHEEL.—Wherein the demountable rim may be easily taken from or placed upon the wheel by persons of ordinary skill, without special tools. Patent 1552743. H. M. Howell, Monroe, La.

SPRING SUSPENSION.—Which will support the power plant of a vehicle, particularly a Ford car, and will dampen the vibrations of the engine. Patent 1552823. G. M. Chambers, Hollister, Cal.

AIR BRAKE.—A four-wheel brake for automobiles, with a brake cylinder to each brake drum, thus eliminating complicated mechanical action. Patent 1553966. C. R. Trotter, 5710 Fourteenth St., Detroit, Mich.

HEADLIGHT TURNING DEVICE.—Whereby the movement of the headlights upon their vertical axes relative to the steering wheel may be determined and set at will. Patent 1554142. W. M. Thomas, 854 E. Pershing Rd., Forrester Hotel, Chicago, Ill.

AUTOMOBILE BRAKING DEVICE.—Which will be applied instantly when the operator's foot is released from the accelerator pedal. Patent 1554078. L. Fleischer, c/o Berkowitz & Solomon, 604 St. Mary's St., Bronx, N. Y.

CHAIN TIGHTENER.—Adapted for use in tightening tire chains, or in the emplacement or removal of the tire. Patent 1554874. W. H. Michael, 1227 E. Boulder St., Colorado Springs, Colo.

PORTABLE OIL-DRAIN PAN.—Easily removable from place to place, to receive the oil as it is removed from an automobile crank case. Patent 1554589. L. D. Long, Charleston, S. C.

ANTI-RATTLING GEAR.—Which is constructed to prevent the constant rattling of gears, especially those which operate the cam shaft. Patent 1554889. E. H. Smythe, 5937 Beaufort St., Detroit, Mich.

GAUGE.—Adapted for use in lining up the king-pin holes and spring saddles of the front axles of automobiles. Patent 1554324. R. S. Beeler and M. L. Akers, Pendleton, Ore.

VEHICLE BRAKE.—Of that type which includes relatively movable disks, one of which is rotatable while the other is stationary. Patent 1554573. R. C. Griffith, Conrad, Mont.

Designs

DESIGN FOR A DIAL FOR RADIO SETS.—Patent 68079. M. Atkin, 1823 Marriion Ave., Bronx, N. Y.

DESIGN FOR A TICKET-DISPENSING BOOTH.—Patent 68092. G. A. Dicker, 936 So. Grand Ave., Los Angeles, Cal.

DESIGN FOR A LOUDSPEAKER.—Patent 67974. M. T. Robinson, 324 W. 12th St., Long Beach, Calif.

DESIGN FOR A WATCHCASE.—Patent 68-152. M. Mogilevsky, 121 Fulton St., New York, N. Y.

DESIGN FOR A DRESS.—The inventor has been granted two patents, Nos. 68134 and 68135. T. Davis, c/o Franklin Simon & Co., 38th St. and Fifth Ave., New York, N. Y.

The Scientific American Digest

A Review of the Newest Developments in Science, Industry and Engineering

Conducted by Albert G. Ingalls

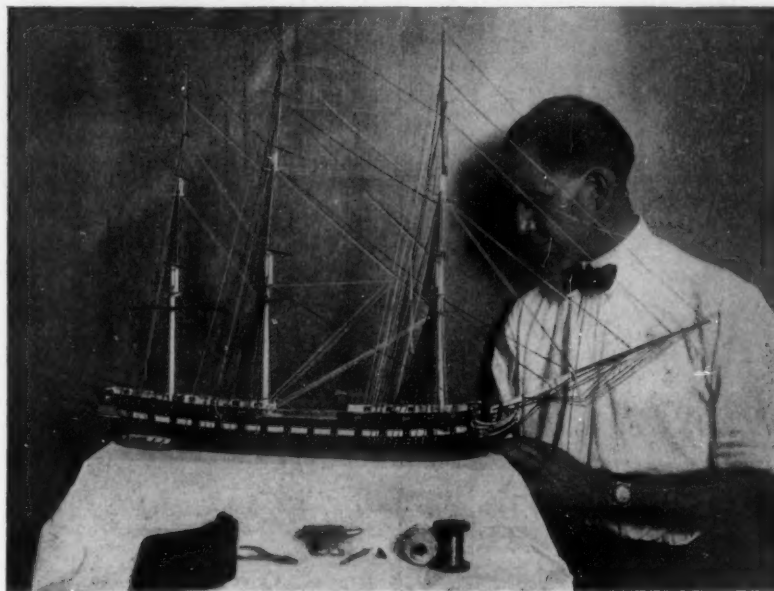
"Old Ironsides"—Building a Scale Model

How would you like to possess an exact replica of "Old Ironsides" (the *Constitution*), America's most famous warship? Our illustration shows you how this can be secured at a cost of \$4.50 plus; the "plus" representing over one year's patient and skilful work during the leisure hours of the day. Mr. Robert Jacob, Jr., son and associate of Robert Jacob, the well-known yacht builder of City Island, will tell you that if the evening hours spent, and yet to be spent, upon the job were grouped in an unbroken stretch of day-by-day labor, it would represent four or five months of continuous work; and the job is by no means finished yet. It is these eight to nine hundred hours of work which explain, in some measure, the price of from \$800 to \$1,000, which such a faithful and exquisite model as this is bringing among the collectors of warship models.

Not that the model maker, in this case, was building to sell. Only when it is a labor of love will anyone endure the tedious labor involved in making an exact scale model of a warship, replete with every spar, rope, block and the multitude of *et ceteras* called for in an exact ship model. The appeal of "Old Ironsides" is so many-sided. She speaks to us as an expression of the highest development of the shipbuilding art of her day. She appeals to the patriotism, romance, imagination and poetry which in greater or less degree, surely, are to be found in every ardent and intelligent American when he dwells on the history of his beloved land; for the *Constitution*, by her swift and telling sea victories, won at a time of national discouragement, struck fire in the national breast and begat instant recognition of our naval genius throughout the world.

The model is built to a scale of $\frac{1}{4}$ inch to the foot; it is therefore about 1/100 full size. Mr. Jacob built it mainly from plans drawn by C. G. Davis and based upon careful researches. Among these were the original plans, dated 1794, which we reproduced in our article on pages 20 to 22 of our July, 1925, issue. Very wisely, the sails will be omitted. Sails stretch, become discolored, and destroy the trim ship-shape look of a model.

The hull is reproduced from the waterline up and is built up of layers of white pine. The deck is of white holly, ruled in ink to represent the seams, and varnished. The



Model of "Old Ironsides" and its builder, Mr. Robert Jacob, Jr.

trim is of teak. A stand is omitted because it is cumbersome. Instead, the flat bottom of the model is weighted with lead to prevent accidental upsetting. The masts and yards, of spruce, were planed down to the round and tapered by handplane. The shrouds are white, stranded cotton, tarred and spliced into the deadeyes, which, like the multitudinous blocks, were made by hand from hardwood.

As an evidence of the literalness of the model, note that all rope connections are spliced; even the topsail yard braces, which are of silk cord the thickness of a pin, are carried around the tiny blocks and spliced. Did the builder, we wonder, use a needle as a marlinspike in this Lilliputian job? The yards are equipped with their full complement of halliards, sheets, braces, and so on. The sheets lead down to diminutive pinrails at the foot of the masts, and the braces lead aft to pinrails on the bulwarks. To secure a trim and true appearance of the ratlines (that failing point in so many models), they were rove with fine copper wire. Hence the smart appearance of the shrouds. When the 54 guns (turned in wood and brass) are in place, and the rigging has been done, the model will be complete.

Another Method of Telegraphing Pictures

GERTRUDE EDERLE, champion swimmer, had hardly left the water in her attempt to swim the English Channel during August before her picture, taken during this particular swim, appeared in American newspapers.

The public has already become accustomed to seeing telegraphed pictures, but it is impracticable to send these by submarine cable because a cable does not operate in the same manner as a land telegraph wire. The familiar methods of picture transmission by wire show their own earmarks on close scrutiny, although there is no real objection to this, for it does not injure their news value. If you study closely the pictures transmitted by one of these land processes you will find that they are made up entirely of parallel lines crossing the picture, each line changing from thick to thin and back again as frequently as necessary in order to bring out the desired combination of light and shadow. This method is almost entirely automatic.

Peculiarities affecting submarine cable transmission make it difficult, however, to employ this process in transmitting pictures across the seas. Hence, another system, not

open to these objections, had to be devised.

By means of this transoceanic system, which is one of four processes devised by LeRoy J. Leishman, of Ogden, Utah, the picture to be transmitted is divided up into five degrees of tone value, every area of shade being outlined. These boundaries are traced with a stylus attached to two relatively moving scales, the readings on which comprise a record of absolutely every movement described by the stylus in the tracing process.

This mechanical process is based upon the fact that all lines are either straight or curved, and that all curved lines can be divided into component parts that are arcs of circles. When the arcs change, a single reading of the scales records the fact. All these readings are in letters, instead of figures, and the sum total of them comprises a message that can be transmitted by telegraph or cable. The code also indicates the exact depth of tone of each shadow area. A sample of the code by which Miss Ederle's picture was transmitted to America from England follows:

LONDON COLLECT 233 FIRST 50
NANEWSAL NYK

FOLLOWING FIRST HALF PHOTO-
GRAPH EDERLE ABOUT TEN
MILES GRISNEZ EDERLE CODE
BEGINS JDBTS XXBTA XXLGA
JDLCA JDBTD UIGIS UJGCU
UGCFU UFGFA UFFWA UFFSQ
UGFLQ UJFDQ UTEVO VOEWA
VSFAQ VVFDA VXFVA VXGAQ
WAGAQ WBGFO VWGJA VWGKA
VTGKA VQGCQ VMCFQ

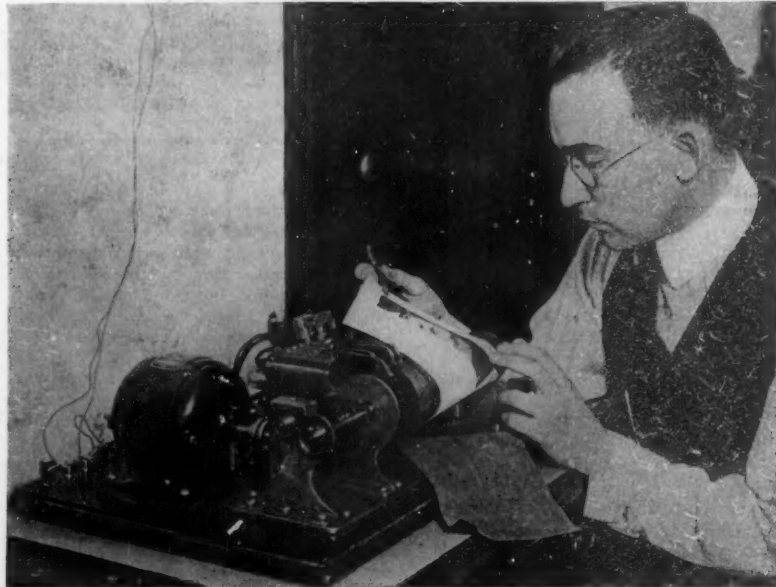
At the receiving end, the decoding device is operated according to the code, as received, and, by reversing the transmitting process, a synthetic picture is built up that is an exact duplicate of the original photograph. So accurate is the reproduced picture that it will superimpose with the original to 1/100 of an inch.

The picture which we show on this page was taken in mid-channel at about one o'clock and rushed to Dover, England, by speedboat. It was telegraphed by cable to the North American Newspaper Alliance in New York, 548 groups of letters similar to those quoted above having been required to complete the picture. It appeared immediately in the *New York World*, and in addition, it was re-telegraphed to the *San Francisco Bulletin*, the *Chicago Daily News* and other newspapers by the telephotographic process of the American Telephone and Telegraph Company.



Courtesy of Metropolitan Newspaper Service

The synthetic picture of Miss Ederle swimming in the English Channel



Courtesy of Metropolitan Newspaper Service

Mr. Leishman and his decoding machine for cabled pictures

Washing a Million Milk Bottles a Day

"How under the sun do they manage to get all the emptied milk bottles clean again?" A few are rinsed in the home to which they have been delivered, before they are set outside for collection. The majority return with a film of dried milk on their inner surfaces. Others receive all sorts of contamination. People use milk bottles for all sorts of purposes other than for milk, and finally return them in anything but a sanitary condition, to the milk company. The milk company cleans them. It cleans them clean—not merely comparatively clean. It not only cleans them, but it sterilizes them. This is done by machinery, at least in the large cities. If it were not done by machinery, your milk would cost you more, for hand labor is costly.

In the city of New York, about 1,000,000 milk and cream bottles are distributed every day. Of these, twenty percent do not return; they are broken, thrown away, or are used for other purposes. That means that 800,000 bottles return daily to be washed.

How much do we pay for washing the returned bottles? Not much. A machine does it, and so many bottles are washed in a short time that the charge against any given bottle is very low. One of these machines is shown in the illustration on this page, and the fact that it can handle 250,000 bottles per day shows how many human bottle washers with flying fingers it displaces.

Study the drawing showing the machine in cross-section, beginning at the right end where you see a man feeding dirty bottles into bottle-shaped pockets. Then follow the arrow, for the drawing explains itself. Each soaker pocket through which the bottles pass on an endless belt is ten degrees warmer than the last. The solution used is caustic soda. But this is not the actual washing, for the actual washing takes place in the machine on the left.

The little machine in the center is interesting. It reverses the bottles—turns them upside down so that the water that is to be shot into them under pressure in the washing machine will run out again. The internal sterilizing takes place at 210 degrees, Fahrenheit, practically the boiling point of water. Note that there are no brushes; these would carry contamination from bottle to bottle. Note also that when the sterilizing has been done, the cooling water is applied to the outside of the bottle, only, and not to the inside which has just been sterilized. Even the carrying caps into which the bottles are inserted at the beginning are designed in such a manner that water cannot adhere to the lips of the bottles and thus possibly carry over contamination.

The washed and sterilized bottles finally issue from the machine, cooled to ordinary temperature by their passage from the hot sterilizer to cooler and cooler compartments, so that there is practically no chance of dirt passing through, from the caustic soda of the soaker to when the cleansed bottles issue from the washer. Nevertheless, the man who watches the bottles issue from the machine, keeps his eyes glued to the chain of bottles, which are strongly illuminated by a powerful, shaded electric light, and if he sees anything doubtful, out comes the bottle for special treatment.

Contrast all this process with the older method of washing bottles by hand, with the difficulty of keeping the cheap help necessarily employed up to high standards of cleanliness. It is a kind thing to return your used bottles to the milkman, washed and clean. But don't imagine that this is the only cleaning they get.

Man Learns the Secret of Rickets

DURING the past few months the leading scientific journals have contained many interesting articles concerning the remarkable similarity in effect on the human organism between natural light and ultra-violet light, as well as certain foods containing large amounts of vitamins. The evidence so far

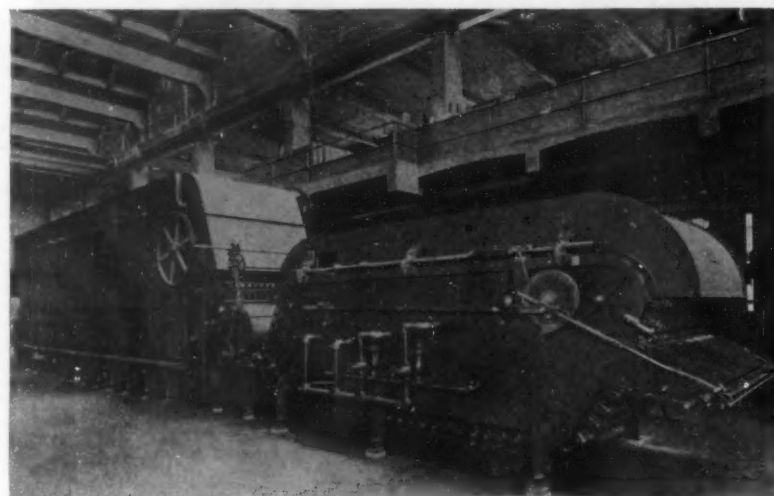
worked out indicates that we are probably on the eve of the conquest of the deficiency disease known as rickets.

Rickets, or rachitis, seems to be primarily due, not so much to a deficiency of the bone-forming calcium and phosphorus in the diet itself, as to the inability of the body to make use of that which is provided. It is now known that ultra-violet light, either from the sun—a weak source—or from a special quartz lamp, has the effect of enabling the body to make use of the available bone-forming elements in the food.

The most interesting development of the train of scientific research which is bringing

ultra-violet radiation reaches us in the largest quantities, as Dr. Hess has shown. Dust and smoke-contaminated city air is still more effective as a stop for the ultra-violet rays of the sunlight; while the least thickness of glass shuts off this invisible component of the sun's radiation as if it were a stone wall. Therefore, we have discovered why indoor life has contributed so largely to the prevalence of rickets. We can also see why there is little of it in our country districts.

Ultra-violet light from the sun—even in pure, transparent air—is much weaker, however, than that which is shed by artificial lamps enclosed by quartz. The latter are



Courtesy of Barry-Wehmler Machinery Co.

Here is the machine in which they wash our milk bottles

us into control of rickets is the discovery that it makes no difference whether the rachitic infant is exposed to ultra-violet rays or whether the food which he is about to eat is exposed. The effect is much the same.

For centuries the fishermen of Norway and other Old World countries have known that cod-liver oil was a strong remedy against rickets. They did not, however, know why. In part, at least, we now know. This oil is very rich in Vitamin D; and Vitamin D acts as a preventive of rickets. What, then, is the connection between this fact and the fact that ultra-violet light produces the same effect? It is not merely a coincidence. The codfish eat organisms which feed on microscopic plant-like life called algae; and these algae in turn make their own supply of Vitamin D through direct exposure to the ultra-violet rays of the sunlight.

at least thirty times as strong in the ultra-violet. It is believed that such lamps will soon be used quite generally, under the care and regulation of physicians, for administering brief daily treatments to children in the crowded cities.

What actually takes place when the radiation strikes our bodies, or when it strikes the food we are about to eat, is not wholly known as yet. Certain it is that it is not a direct effect. Some scientists believe it activates certain substances called cholesterol in animals and phytoesterol in plants—both substances being similar—and at the surface, only. By means of the blood, this effect is later carried inward to the bones, where it takes effect, enabling the bones to accumulate the necessary stiffening substances from the materials brought to them in the usual manner. It is due to some photo-chemical effect, like that which en-



Courtesy of Barry-Wehmler Machinery Co.

And here is a cross-section showing how the milk-bottle washing machine works. It explains itself

Thus, whichever way we choose to take our ultra-violet ray effect—whether directly from the sun, whether from special quartz lamps, or whether from cod livers in which it has been stored—we may obtain the same effect, enabling our bones to build themselves up from the calcium and phosphorus in our diet. Conversely, we see why no amount of calcium stuffing would be of any use whatever without the necessary ultra-violet ray effect which makes it available to the body.

In our northern latitudes the sun's light is forced to penetrate through many miles of atmosphere, for it strikes the earth's surface at a greater angle than in the tropics. Thus, in the temperate zones, the air filters out the ultra-violet ray to a large extent, and we get comparatively less value from it. No rickets is known in the tropics. It is when the sun is well over head that its

ables us to take photographs on a plate or film coated with chemicals. Some think that vitamins are actually created by the action of ultra-violet light. At any rate we now understand the effect fairly well, and we are thus in a much better position to control it.

Not all brands of cod-liver oil contain useful amounts of Vitamin D. Some are almost lacking in this ingredient; and while we cannot here specify the best brands, the physician knows them.

There is still much concerning the new method remaining to be learned and scientists are hard at work on the problem. Much valuable work has been done already by Dr. Alfred S. Hess of Columbia University, by Dr. H. Steenbock of the University of Wisconsin, by Dr. E. A. Park of Johns Hopkins University, and by Dr. Bowie of Harvard University.

Why Not Grow Our Own Rubber?

THE Philippine Islands, properly developed, are capable of producing one-fifth of the total amount of crude rubber now consumed in the United States, according to the authorities of the United States Bureau of Commerce whose report has been summarized in the August 20, 1925, issue of *Automotive Industries* (New York).

In the three islands of the Philippine group suitable for rubber culture there is an area of about 1,500,000 acres which could be used for this purpose. If fully planted with rubber trees, this acreage would produce 70,000 tons of good-grade, Para rubber yearly.

Great Britain has recently restricted the export of rubber in such a way that its price on the American market has gone up considerably. Great Britain and The Netherlands produce most of the world's rubber supply on plantations in the East Indies and in India. The wild rubber of Brazil, which was the original source of our rubber, no longer exerts much influence in the world's rubber market. The Brazilian rubber tree, *Hevea brasiliensis*, has been transplanted to these distant localities where rubber can be produced by regular culture—just like apples in an orchard—and where labor, working regularly at regular wages, can be controlled efficiently. The Brazil rubber is secured by free-lance gatherers, most of whom are Indians whose labor cannot be controlled so as to insure a regular supply of rubber, as they will not work longer than is necessary to bring in a barely sufficient sum to provide a few trinkets.

These unfavorable South American conditions caused the rubber growing industry to be shifted to the Far East. It so happens, then, that two foreign nations control practically the world's supply of rubber, while the United States uses most of the world's supply. With the recent British restriction acts which had the effect of driving the price of rubber up, new ways to obtain rubber more cheaply have been sought by the American importer. Recently a large American rubber company made a deal with the Liberian government in Africa whereby immense areas in Liberia are to be devoted to rubber culture. Now the Philippines are possibly to be exploited.

Many have asked why, with the Philippines so close to those parts of the East Indies in which rubber culture has been such a success, we have not grown our rubber there. The climate is suitable and the labor is available—why not go ahead? But rubber investors have feared to put money into plantations in these islands as long as there was so much uncertainty about the political situation.

If the likelihood exists that some future administration at Washington will turn the government of the Philippines over to the Philippine natives, with the possibility that the islands will then get into the control of local political bosses whose past record provides little cause to anticipate such an eventuality with joy, then those who had invested their money in rubber plantations in these islands would stand to lose large sums. We should thus fail to ensure for ourselves dependable, steady supply of rubber grown on our own soil.

The report of the government experts shows that rubber growing is practicable in the Philippines, and that the production there of the possible one-fifth, even, of our needed supply would tend very strongly to beat down the prices of competing foreign products on the American market. The Philippine climate is now shown by the Department of Commerce to be as good for rubber culture as that of the British and Dutch East Indies, while there are large areas in our Philippine Island possessions that are still better in soil, in topography and in their accessibility than the British and Dutch possessions.

The localities selected as suitable for rubber plantations are in the southernmost islands of the group, especially in the large island of Mindanao, and in Basilan and

(Continued on page 406)

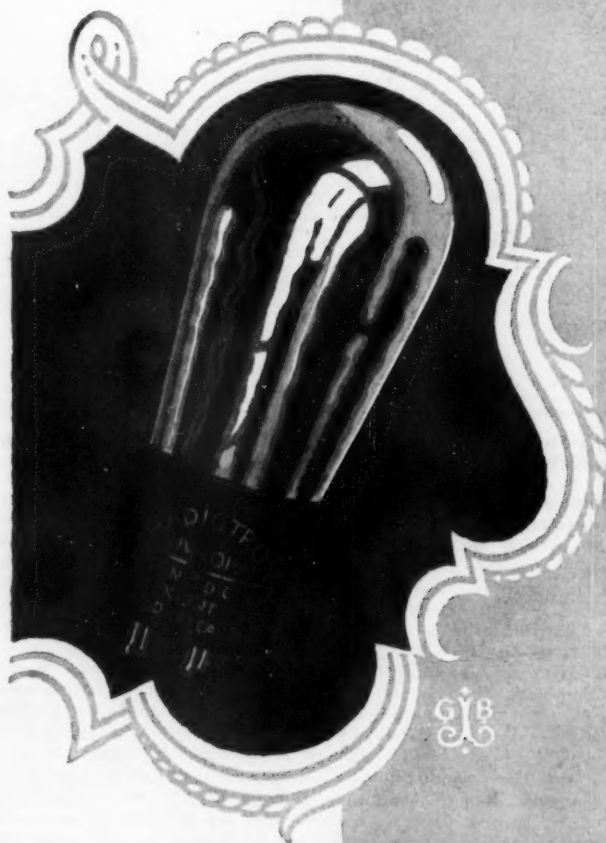
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Jolo as well. Jolo is one of the Sulu group of islands which are part of the Philippines. Some cultivated rubber is already being grown on these islands, and these plantations have made out well. An estate of 795 acres, owned by the Basilan Rubber Company (Swiss), of the Island of Basilan (see the map) consists of 89,500 rubber trees. The Rio Grande Company (Scottish-American) has a plantation at Kabakan in the central part of the large Mindanao Island; while the American Rubber Company has a plantation of 1,600 acres planted with 175,000 trees, and the Zamboanga Development Company (Japanese) has an estate on the Zamboanga peninsula of the Island of Mindanao. The trees on the several estates range in age from four to eleven years. Thus we are not without previous experience with rubber culture in the Philippines.

However, the total export has been small, not more than ninety-five tons in any one year, for it takes many rubber trees to supply a large amount of rubber. The total present Philippine acreage in rubber, 2,900 acres, is only a drop in the bucket compared with the 1,500,000 acres considered available there by the government experts, an acreage which, even at that, would supply only twenty percent of our present demand. With about one hundred rubber trees per acre, the average yield is about 400 pounds of rubber. Thus it will be evident that rubber trees do not yield rubber milk in proportion as maple trees yield sap. (Rubber latex is not the sap of the rubber tree, which has its sap in addition to the latex or "milk.")

The average cost of bringing the forested land into rubber production will be about \$400 an acre.

with the aid of Mrs. Brashear, made an objective lens of five-inch diameter and a mirror of twelve-inch diameter for a reflecting telescope they decided, with much misgiving, that he should take up the new work as an avocation, hoping to earn extra money in this manner.

An advertisement was inserted in the Scientific American in 1880, while he was still employed during the daytime as a mill-

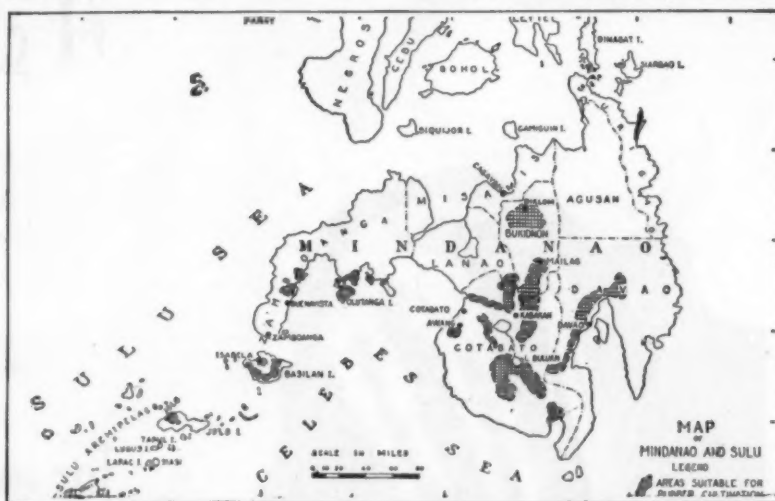
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You can make your own telescopes by getting a silvered glass speculum and diagonal, and mounting them your- selves. I will furnish specula from 3 to 15 inches diameter, of finest quality, at half the cost of imported ones. Instructions given to purchasers for mounting their own instruments. Address, with stamp,
J. A. BRASHEAR, No. 5 Holt St., Pittsburg, U. S. A.

This little advertisement, reproduced from the Scientific American of October 30, 1880, gave Mr. Brashear his first telescope business

right. "Alas for me," he writes, "Hundreds of inquiries came to me from that advertisement. I had no clerk, and I was still hard at work in the rolling mill—up early in the morning, home after six. How was I to answer those scores of letters? And how make specula for those who wanted them?"

Make them he did—at least some of them, but it brought him a nervous breakdown. The upshot of this fortunate event was that he gave up his regular work and made a vocation of his former avocation.

The business grew slowly. Brashear was no business man; people cheated him easily. A great benefactor of science, William Thaw, Sr., soon discovered Brashear and made an institution of him. He advanced him small sums of money, telling him he could pay them back later. Then he put him on a



Map of the southern half of the Philippine Islands, showing the areas in which government experts now report that rubber can be grown economically

One of America's Humanest Scientists

At the age of fifteen a bright lad, full of interest in everything pertaining to mechanics and science, left his country home, went to Pittsburg and began an apprenticeship. He hoped, if he were diligent, to become a good patternmaker. At the age of eighty, in 1920, John A. Brashear, the same lad grown old in years but not in spirit, died, famed as one of the organizers of one of the world's most famous manufactories of telescope objectives.

The autobiography of John A. Brashear (Houghton, Mifflin Company, Boston) has just been published. We have read every word of it, and enjoyed it immensely. Here was a youth whose remarkable qualities soon won him the responsible position of a mill-right; whose still more remarkable perfection of workmanship on small telescope lenses made in spare time won him recognition from the most exacting astronomers.

Brashear was a modest man. Whatever success he won he always found a way to credit to his wife, who helped him, not only with kindness and counsel, but who actually helped him in the tedious work of grinding and figuring his first objectives. When he,

regular salary basis, Thaw getting his own return from the satisfaction of aiding science and in making it possible for a born genius to express his talent in refined workmanship.

The list of important telescopes for which Brashear provided the optical parts is included in his autobiography. His organization's greatest achievement was the seventy-two-inch mirror for the Dominion Observatory, in British Columbia, a glass exceeded in size by only one other in the world. When it was made he was already an old man, yet he gave it his personal attention.

Expert as was the work of figuring the surface of this magnificent piece of super-workmanship, and bringing its surface to within one-400,000th of an inch of absolute mathematical perfection, Brashear was far more than a grinder of great lenses. Universities honored him, and scientific societies awarded him membership.

When he died his ashes were placed in a special niche in the crypt of the Allegheny Observatory at Pittsburg. On its marble slab, at the time of his wife's death he had caused to be engraved for both of them the single sentiment,

"We have loved the stars too fondly
To be fearful of the night."

Another Triumph for **MICARTA**

REG. U. S. PAT. OFF.

Westinghouse manufactures,
also, a complete line of Mi-
carta tubing, instruments, and
Rectigon Battery Chargers.

Front Radio Panels PUNCHED

Another pioneering achievement for Westinghouse Micarta! Now, front radio panels of any size, with fine, highly finished surfaces, can be *punched*. It's Micarta "432".

Zip! With every downward stroke there's a new, beautiful panel ready for business, its lustre unmarred, its value enhanced. No bulges here, no chips, checks, breaks, or cracks.

Three years before the birth of Radio Broadcasting, Westinghouse began experimenting toward a product like this. Then, laboratory engineers were thinking in terms of Micarta for general insulation purposes. Radio, as we know it today, was but a dream.

And so today you will find Westinghouse Micarta ready for the volume radio set producers, who, to effect manufacturing economies, will resort more and more to the *punching* of *all* radio panels.

Maybe *you* can use Micarta, the material that will withstand punching, in dull and gloss finishes. Why not investigate?

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY
Offices in All Principal Cities • Representatives Everywhere
Localized Service—Men, Parts, Shops



What can **MICARTA** do for you besides things like these?

Airplane Firewall	Jumper Bushings
Airplane Propellers	Knobs
Bushings	Liners
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Bus-bar Insulation	Mandrels
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Cable Joint	Insulation
Insulation	Switchboards
Channels	Switch Bases
Cores	Strain Insulators
Discs	Shims
Entrance Bushings	Spacers
Embossed Washers	Spools
Fan Blades	Transformer Spacers
Fair-leads	Telephone
Gears	Apparatus
Gaskets	Valve Washers
Handles	Washers
Ignition Coil Boxes	X-ray Transformer
Impellers	Insulation

A Bit of History Micarta is the pioneer of them all. It dates back to 1904, when the American rights to manufacture it were purchased from a Swiss Engineer named Emil Haefely. As far back as 1905 Westinghouse was manufacturing Micarta tubing for insulation purposes.

In 1911 it was first made into plates, which in 1913 resulted in the first gear of its kind

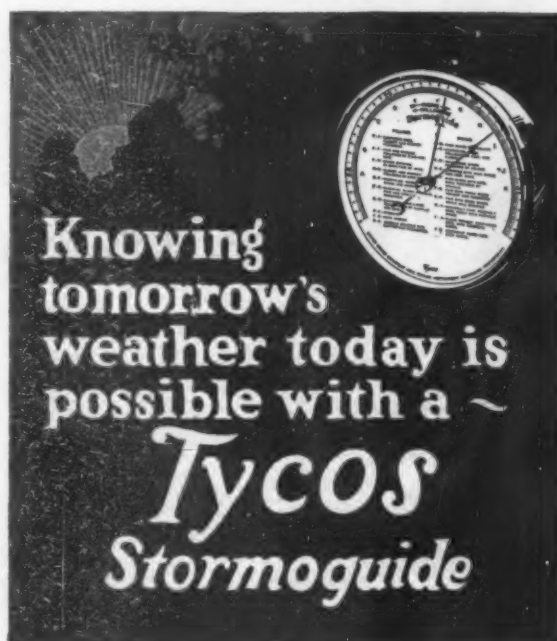
ever made—a silent gear for automotive equipment.

That same year another Westinghouse man first used Micarta for industrial gears. You know how many industrial *quiet* gears are in use today!

And thus, Micarta, born of a pressing need for an insulating material of high structural strength, has demonstrated down through the years its right to leadership.

Westinghouse

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PLAN your work and pleasure according to the weather. The Tycos Stormoguide is a veritable clock of the air. Not a toy but a scientific instrument that forecasts weather 12 to 24 hours ahead.

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Learning to Use Our Wings

Aircraft are being put to use in peace as well as in war. This department will keep our readers informed of the latest facts about airships and airplanes

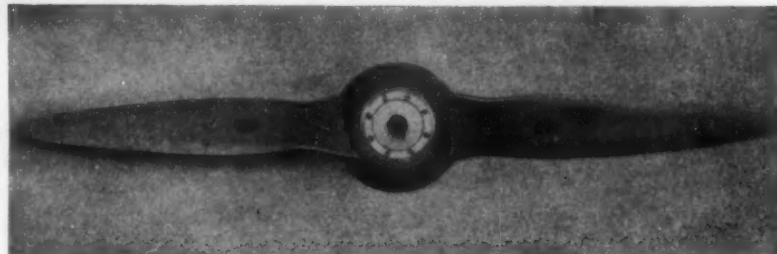
Conducted by Alexander Klemin

In charge, Daniel Guggenheim School of Aeronautics

Shooting Holes in the Propeller

THE vulnerability of the propeller to gun fire is an important military problem. Wooden propellers succumb fairly readily under fire, but the Curtiss-Reed duralumin propellers, invented by Dr. S. A. Reed, show an extraordinary toughness under punishment. A series of experiments at McCook Field, the Army's experimental flying field, demonstrate this in striking fashion.

The first of our photographs shows the propeller, used on a Curtiss Pursuit plane with a 400-horsepower engine, before any serious damage had been inflicted on it. The second photograph shows the same propeller with its blades almost cut through with 30 caliber bullets. Badly as the propeller was damaged, it withstood without failure a whirling test at 2,450 revolutions per minute with an overload up to 1,112 horsepower, or nearly three times its normal rating.



Upstream face of the propeller after hitting the blade three times with 30-caliber bullets from a standard army shoulder rifle. In this condition the propeller withstood a speed of 2,038 revolutions per minute on electric testing motors

Of course, it would be folly to fly for long with a propeller as badly damaged as this one was. But the chances of enough hits to put the duralumin propeller out of business in actual fighting seems very remote, if these tests are given credence!

Shock-Absorbing Hulls

LIEUTENANT N. A. OLECHNOVITCH, formerly an officer in the Russian Navy, describes some extremely interesting experiments with shock-absorbing hulls in a paper before the London Institution of Aeronautical Engineers. A curious experience led to the invention of hulls of this type. Even in the roughest sea, with a strong wind blowing, there may occur waste "fields" of

waves perfectly. The usual unpleasant hammering in rough seas within the harbor disappeared to a large extent. In open seas with long waves the shock was absorbed at least to some extent. Unfortunately, alteration of the step made the getaway more difficult, and on irregular waves there was an unpleasant sea-saw motion of the waves due, probably, to the rebound action of the springs. After some experiments with a double bottom, comprising an air cushion, it was decided that the shock absorber should not be one continuous affair, but be divided into many small, flexible and separate shock absorbers.

The diagram in Figure 2 indicates how this was done. The arrangement consisted



The blade shown in the above photograph was hit 7 times, the other blade 11 times, with 30-caliber bullets from an army rifle. In this condition the propeller withstood a speed of 2,450 revolutions per minute on electric testing motors

comparatively smooth surface. Such a field may last only a minute, but if the pilot can maneuver his flying boat into the field, he can utilize this precious minute to turn into the wind and make a getaway. To find the field the pilot tries to keep on top of a wave, steering diagonally across the wave to compensate for its motion. By skill and good fortune, Lieutenant Olechnovitch managed to find such a field when negotiating a very rough sea, managed to head into the wind and to get his boat off the water. But before the flier was well up in the air, the

of several rows of wooden planks, fixed to the bottom of the hull by one end only, leaving the other free to vibrate. Every row overlapped the next, so that the arrangement gave the appearance of fish scales made of square pieces. All sharp knocks from short waves disappeared, longitudinal rocking stopped and the getaway was as quick as with the hull unburdened by the shock-absorbing device.

The invention carries with it the disadvantages of extra weight and some slight
(Continued on page 410)



Cast iron and platinum —precious metals both!

If a pound of platinum is worth saving, why not a pound of scrap iron? This thought is the magic touchstone that makes even base metals precious at the Western Electric telephone factory.

But here modern alchemy is only one part of a highly organized battle against waste. Lost time, false motions in manufacturing, inefficient ways yield one by one.

Nor is this the work of just a few years. Your telephone today stands as a symbol of progress because generations of Western Electric experience have helped to make it so.

Western Electric

SINCE 1869 MAKERS OF ELECTRICAL EQUIPMENT

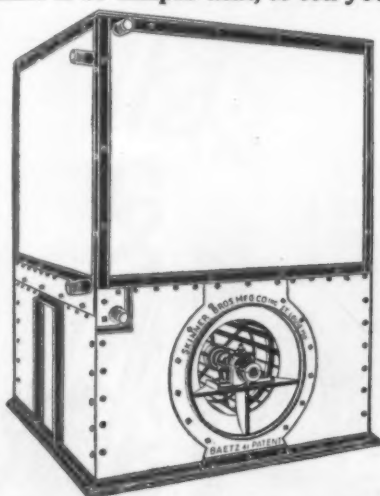
"We have been using these heaters for the past 12 years in one of our other foundries and they give us such satisfaction that when we built this plant two years ago we placed them in here."—Federal Foundry, Indianapolis.

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"After our experience with Skinner Bros Steam Coil Heaters we shall be glad to have you use us for reference any time you see fit."—Crocker-Burbank & Co.

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Skinner Bros staff of engineers will, without obligation, advise with Executives, Engineers, Superintendents, and Managers concerning heating, ventilating and air conditioning systems for mills, factories, plants, foundries, shops and buildings of every size and type. Thousands of prominent manufacturers, large and small of every type in the United States and Canada are users of Skinner Systems.

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\$4.50

Spencer Magazine Carbine

Lever action, 5 shot, caliber 50 rim fire. Weight 7 lbs. 27 inches long; barrel 20 inch; in good order. Price, \$4.50 each. Ball cartridges \$1.50 per 100. 15 Acres Army Goods, New Catalog 1925. 60th Anniversary issue, 272 pages, fully illustrated, contains pictures and information of all American military guns and pistols since 1775, also rifles, revolvers, uniforms, tents, knapsacks, saddles, war medals, etc. Mailed for stamps. Special New Circular for 2c stamp. Est. 1865. Francis Baerman Sons, 501 Broadway, New York City

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Single room and bath \$3.00
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M. P. MURTHA, Manager

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Shaving Brush for its
business end it
will of course be a
WHITING-ADAMS

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Shaving Brushes are
made from selected badger
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and bushy, carries a copious
lather that works in easily
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Every hair is permanently
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BOSTON

Brush Manufacturers for 75 years and the best in the World

complication. Nevertheless it is a promising and valuable idea, and further experiments in England are being followed with interest.

creased considerably by the addition of such fins, and since efficiency is measured by the ratio of the lift to the resistance, the efficiency of the wing is likewise increased

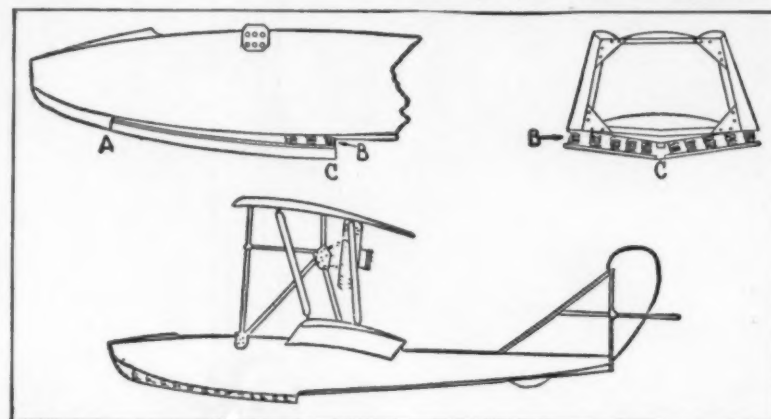


Figure 1: First type of shock-absorbing hull. The bottom of the hull consists of two parts, one an exact replica of the other, with hinges and springs to take up shock

Shielding the Wing Tips

WITH an ordinary wing section placed at a small angle to the wind, the air strikes the under side in such fashion as to produce pressure. The air above the wing is deflected from its straight flow, passing round the contour of the wing rapidly and, therefore, producing low pressure or suction. It is the suction above rather than the pressure below that produces the major

throughout almost all the flying range. At low angles of inclination to the wind, the lift is comparatively small. The increase in lift produced by the shielding tips is therefore likewise small. But the fins have a certain amount of skin friction which is added to the resistance of the wing itself. Hence, at small angles of incidence, the fins lower rather than increase the efficiency of the wing.

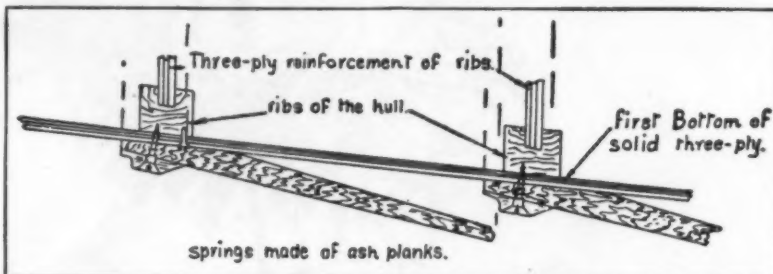
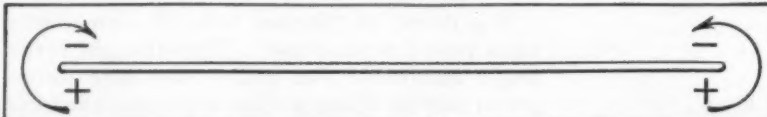


Figure 2: Another type of shock-absorbing hull with a number of springs of ash planks instead of a double bottom

part of the lift—in fact the suction is responsible for at least two-thirds of the lift. Both suction and pressure are necessary, but at the end of the wing certain detrimental effects are produced by this difference in pressure. The air, in fact, tries to flow from the under side to the upper side as shown in our sketch. From this result a swirling motion of the air—"tip vortices" are formed.

These vortices tend to drive the air at the wing downwards, and thus to increase

Shielding fins will not be useful, therefore, for very high speed racers or pursuit planes, but they will improve the landing speed and carrying capacity of commercial airplanes, and also by improving the efficiency of the wing at somewhat higher angles give better cruising and climb. While the advantages to be obtained are not overwhelming, they are worth very serious consideration. The airplane has reached a stage where every possible aerodynamic improvement must be utilized.



There is a region of negative pressure or suction above the wing, a region of positive pressure below the wing. At the end of the wing the air tries to flow in the direction shown by the arrows

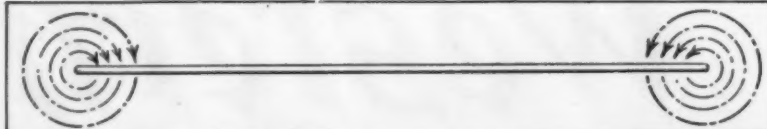
the aerodynamic resistance of the wing. Why not shield the tips of the wings in some manner so as to prevent this end flow and the detrimental tip vortices? A report by the National Advisory Committee on Aeronautics describes some experiments on the shielding of the tips by various forms of fins.

The experiments show that the lift is in-

Winged Defense

COLONEL WILLIAM MITCHELL, former Assistant Chief of the Army Air Service, may be a disgruntled politician or a master mind in the realm of the air. At any rate his recently published book "Winged Defense" is full of weighty pronouncements and startling, but well-based

(Continued on page 412)



The end flow combines with the forward flow to produce tip vortices as shown in our sketch. These vortices drive the air downwards at the wing and tend to increase its resistance



The unseen guardian of all White Truck Owners' earnings

Out of the thousands of White Trucks and Busses built every year a few are selected at random to run their lives out without ever leaving the White factory.

No customer ever gets these trucks. No owner would subject them in years to the gruelling tests they are given in weeks. Yet every White customer profits from their operation.

In a special engineering research building, a separate unit of the great White factory, these trucks and busses help maintain White leadership. They become objects of that study, experiment, research, investigation and proof that goes on quietly and without ceasing.

Practical engineers stand watch. Materials give up their secrets. Engineering ideas score or fail. Design bares its virtues and its defects. Theory gives way to fact. An "improvement" must

demonstrate that it is more than an innovation or a fad. It must improve. It must add definitely to the truck's earning power.

Here is the unseen guardian of all White Truck owners' earnings. Here is the wellspring of the White salesman's confidence when he sells—the power behind the White owner's confidence when he buys.

When a White Truck is delivered to an owner, that owner has the finest truck, in material, design and workmanship, that can be built by the White Company—leaders in motor truck manufacture for more than a quarter of a century. He has the latest and best that is good in a motor truck, built to give the maximum of profitable transportation without interruption.

With all this research, experiment and

vigilance in manufacture, White Trucks are still pieces of machinery. They work longer and earn more when given proper care in operation. So The White Company has spread the boundaries of its factory yard throughout the world. *Quick service, well done at low cost*, is available to White Trucks everywhere.

And White Trucks are everywhere—more of them are in service than trucks of any other high-grade make. White trucks—all models, in all lines of business—give the *most money-earning miles*.

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Let a White salesman show you how White Trucks will make money for you. There is a White Bus or a White Truck model to meet every transportation need. Terms may be arranged. White Truck Chassis, \$2,150 to \$4,500; White Model 50A Bus Chassis, \$4,950; f. o. b. Cleveland.



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STRENGTH—LIGHT WEIGHT—DURABILITY



Standard uses DAYTONS

Here is a Standard Truck, equipped with Dayton Steel Wheels, being loaded with 10¾ tons of cement block. Just an incident in the day's work. Nothing unusual for this truck and its Dayton Steel Wheels. Both have strength to endure ponderous loads. Both are built for exacting service.

Heavy loads, rough roads—Dayton Steel Wheels are ever equal to the task—yet they are light in weight. Electric furnace steel and exclusive hollow-arch construction make the Dayton a light steel wheel of great strength. That's why nearly all leading truck makers use Dayton Steel Wheels. Specify them on your next order.

The Dayton Steel Foundry Company
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Dayton
Steel Truck Wheels

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The One-Profile Engine. Sold Direct From Factory To You.
Easy Terms on best engine built. Burns Kerosene, Diesel, Gas, Oil, Gasoline or Coal. Change power at will. Equipped with the famous WICO Magneto, speed and power regulator and throttling governor. 2 to 25 horsepower—ALL STYLES.
FREE Write today for my Big Engine Book. Sent free—no obligation on your part. Or, if interested, ask for our Log and Tree Saw, 3-in-1 Saw Rig or Pump Catalogs.
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Any amateur can immediately start using his UltraLens to examine the edge of a razor, the mesh of a cotton shirt, the bacteria in dirty water. No technical training required, yet hundreds of scientists and teachers are using this instrument. Gives enormous magnification and perfect definition. Send \$7.50 for complete outfit. Send for descriptive literature.
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prophecies. "Airships have been designed which will go round the world on one change of fuel and airplanes have actually flown for 2,500 miles without landing."

Discussing the meteorological conditions affecting flying: "Cold is no impediment to the action of aircraft. In fact, the colder the weather, the clearer the sky and the better the flying conditions. The sun's rays are what make the most trouble for the aviator."

Night flying is being practiced in the United States as nowhere else in the world. Is it likely to be safe? "Two or three o'clock in the morning is also the best time for flying, because, on account of the coldness of the night, the moisture has been deposited on the earth, the absence of light and heat has ceased to make up and down currents in the air and there are no heavy winds. This is the reason why all migratory birds fly at night in their migrations from north to south. It is really easier for the airman to fly at night instead of the daytime, and in the future much of our traffic, especially for all heavy planes will be conducted at night."



Colonel William Mitchell, former Assistant Chief of the Army Air Service, as drawn by Cesare of the New York World

After discussing the tremendous services that the airplane is rendering in many fields of industrial endeavor, the General makes this graphic statement: "Think of the result of an Air Mail Service between the centers of population in Asia and America which will cut down the time from four or five weeks to from sixty to eighty hours."

We have purposely restricted our extracts to the commercial side of aircraft. But Colonel Mitchell in masterly fashion makes it quite clear that aircraft will have a tremendous, if not a preponderating effect on every type of warfare, land or sea, defensive or offensive.

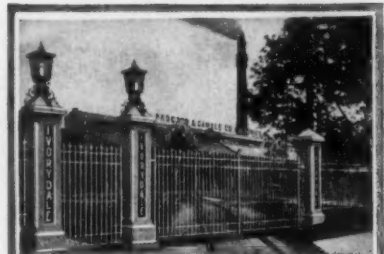
Changing Compression at Altitude

AS the airplane climbs to high altitudes, the engine draws in the same volume of air per inlet stroke, but owing to the rarity of the atmosphere, the weight of air drawn in is less. Since the fuel employed must bear a more or less constant ratio to the weight of air, less fuel is consumed per working stroke at height. Therefore, the engine delivers considerably less power at altitude than on the ground.

To meet this loss of power, complicated superchargers are being employed, and also very high compression engines, throttled by the pilot when flying near the ground. Both schemes have decided disadvantages. The supercharger adds weight and real complication. With the very high compression engine, even when throttled, there is still a danger of preignition and detonation.

Now, Ricardo, famous British internal combustion engineer has successfully applied a totally different principle for maintaining power at altitude: namely varying the inlet valve timing. At ground level the inlet valve is made to close late, thus shortening the compression stroke, and avoiding higher

(Continued on page 114)



A GOOD IRON FENCE

affords permanent protection, improves plant appearances, is a perpetual guard against prowlers. That's the reason so many leading industrial plants have erected

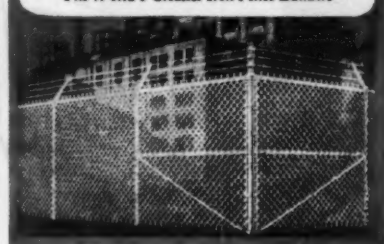
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Chainlink Factory Fence
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Rust-Resisting Copper SteelBlack and Galvanized
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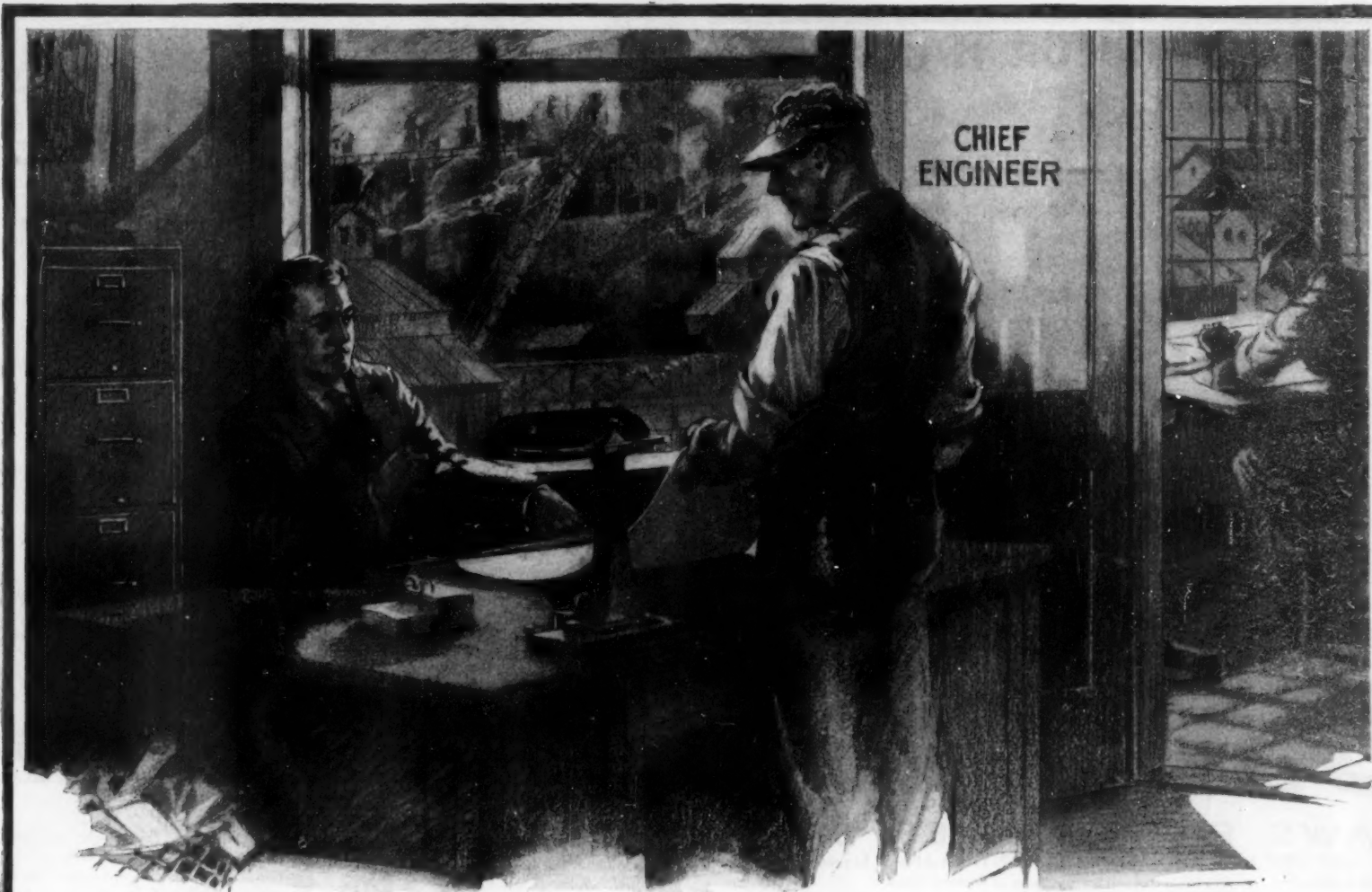
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Secure maximum rust-resistance from all sheet metal products by insisting upon copper-steel. Its excellence is a well established metallurgical fact. The proof is conclusive.

KEYSTONE COPPER STEEL is an alloy made by the addition of a certain percentage of Copper to well made Steel, thereby increasing its lasting and rust-resisting qualities under actual service condition. Unexcelled for culverts, tanks, flumes, roofing, siding, gutters, spouting, and all exposed sheet metal work. Send for booklet giving results of positive time and service tests.

We manufacture Sheet and Tin Mill products for all purposes—American Bessemer Steel Sheets, American Open Hearth Steel Sheets, Keystone Copper Steel Sheets, Black Sheets, Special Sheets for stamping, Sheets for Electrical apparatus, Automobile Sheets, Deep Drawing Sheets; Apollo and Apollo-Keystone Galvanized Sheets, Corrugated Sheets, Formed Roofing and Siding Products, Culvert and Flume Stock; Long Terne Sheets, Roofing Terne Plates, Bright Tin Plate, Black Plate, Etc.

AMERICAN SHEET AND TIN PLATE COMPANY, Pittsburgh, Pa.



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The remarkable growth in the use of sheet steel for the fabrication of a tremendous variety of products has been so steady and consistent, has been accepted as so much a matter of course, that probably few of us realize the profound effects which are being developed from this, not only in manufacturing but in the marketing and sale of goods.

The Material of Universal Adaptability

"It is made of steel" is a statement which nearly always challenges the buyer's interest.

The rapidly developed favor of the buyer for the all-steel automobile body is one outstanding example.

Steel bedroom furniture, only a few years ago used almost exclusively by hospitals, hotels and other institutions, is now rapidly finding its way into the home.

Steel office furniture is today generally regarded as the standard type.

The redesigning of products for production in pressed metal forms one of the most interesting chapters in modern engineering.

From such work has followed remarkable savings in weight and in shipping expense; simplified manufacturing processes, with greatly reduced manufacturing cost; better and stronger products—these are results produced in almost every branch of industry.

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compression than the engine can stand with atmosphere of ground level density. At altitude the valve is made to close earlier, the compression stroke becomes longer and the compression ratio higher. There is now no danger of detonation since the initial pressure is less, yet the ground power is successfully maintained. The device is difficult of application to the conventional "in-line" engines, but on the Jupiter radial air-cooled engine a double epicyclic timing gear is easily applied and makes the variable timing of the inlet valve quite simple.

(here Mr. Stout agrees with Fokker and many prominent designers); third, a speed of 100 miles per hour, with full load when only three-fifths of the maximum horsepower of the engine is employed (this is important because if the engine is not crowded it becomes both more reliable and more enduring); lastly, a pay load of at least four pounds per horsepower, so that a 400-horsepower Liberty-motored plane will really be carrying something to justify itself.

Two other requirements listed by Mr. Stout are quite evidently of primary impor-



The Rohrbach metal flying boat with auxiliary sail equipment offers a solution of the problem of forced landings for seaplanes

A Seaplane Sailboat

IN commenting on the unfinished flight of the PN-9 from San Francisco to Hawaii, we discussed the advantages of some auxiliary system of navigation, when engine trouble or lack of fuel had forced a seaplane down and left it helpless.

The Rohrbach metal flying boat with auxiliary sail equipment offers one solution of the difficulty. We have already mentioned this sailplane in our columns, but the appended photograph gives a more illuminating idea of the device.

The seaplane is equipped with telescopic masts of duralumin weighing in the neighborhood of 150 pounds. To these telescopic masts, sails of various areas, between 270 and 800 square feet have been fitted without difficulty. With an adjustable water rudder, the craft shows good sailing characteristics and has navigated at some 10 knots in a moderate wind.

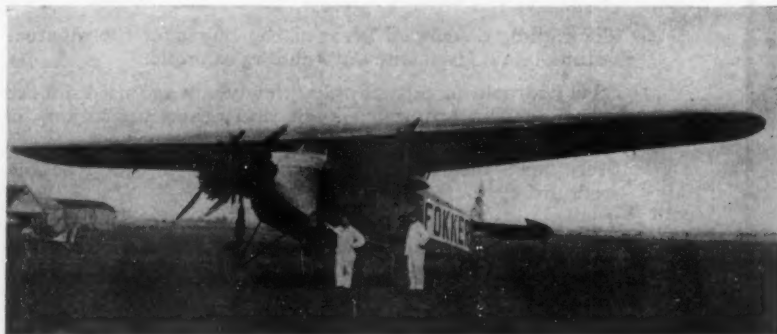
tance. One is a thoroughly reliable air-cooled engine, preferably without electric ignition! The other is apparatus for aerial navigation which will be absolutely dependable. Perhaps some form of radio direction finder will meet the needs of air navigation.

The Most Powerful Aero Engine

THE Engineering Division of the Army Air Service has designed an experimental engine which is expected to develop 2,400 horsepower. The new engine is of the "X" type, with four banks of six cylinders arranged in the form of an X, and will be supercharged and geared down. It is to be built by the Allison Engineering Company of Indianapolis and if successful will be the most powerful aero engine in the world.

A Three-motored Fokker

POWER plant failures are still the main cause of forced landings and are suffi-



A front view of the new Fokker three-motored plane whose power plant provides a maximum protection against engine troubles and forced landings, at rest at Hazelhurst Field, Garden City, Long Island

The Ideal Airplane

DISCUSSING the operation of the Ford Air Line before the Society of Automotive Engineers, W. B. Stout states with great authority the ideal requirements of commercial aviation: First, comes absolute reliability of structure under all conditions of weather or fire hazard (this has been largely accomplished already); second, absolute dependability of the power plant accomplished by the use of multiple engines

ciently frequent to affect flight reliability seriously. But in a three-engined plane, the chance that all three engines will fail simultaneously is extremely remote. With one engine out of commission continuation of flight is easy, and with two engines out of commission a gentle glide downwards becomes possible. Therefore a multi-motor power plant adds greatly to security. Our illustrations show a very interesting new design by Anthony H. C. Fokker, the famous

Dutch designer, now settling permanently in the United States, which employs three air-cooled Wright "Whirlwind" motors of 200 horsepower each.

The security against power-plant failure is enhanced by the nearness of the outboard motors to the center line of the airplane. The tips of the two rear propellers actually pass within the projected circle of the front propeller, although this is not quite evident from the photographs; so that if an outboard motor fails, the eccentric or unbalancing turning couple is reduced to a minimum.

The new Fokker carries two pilots, placed forward under the wing, eight passengers in a comfortable enclosed cabin, 300 pounds of baggage and five hours' fuel; and it develops a maximum speed of over 100 miles per hour. The support of the two outer engines from the monoplane wing is simple and effective. It is also interesting to note the large tread of the wheels, giving a maximum protection against sideways tipping on the ground, and the generally rugged appearance of the craft.

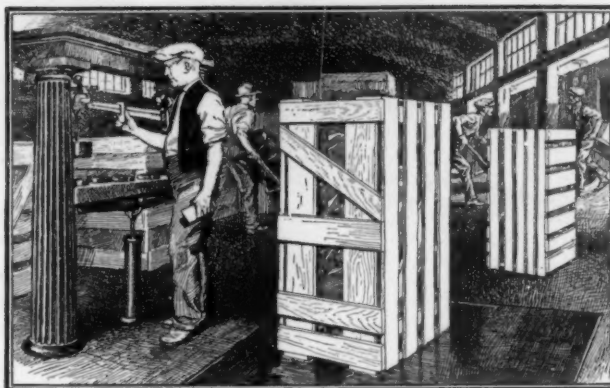


Wide World
Mr. Fokker climbing up the wheels of his new design to examine one of the Wright "Whirlwind" motors. With him is Charles L. Lawrence, president of the Wright Aeronautical Corporation which is responsible for the construction of this 200-horsepower engine, considered perhaps the most highly developed air-cooled aero engine in the world.

There is another interesting tendency of airplane design illustrated by this passenger-carrying giant and that is the tendency to use air-cooled engines instead of water-cooled engines. The air-cooled engine removes the need for a complex water-cooling system and a great deal of weight is saved thereby. The saving in weight increases both the commercial pay load and the performance. It is a significant fact that the Wright Aeronautical Corporation has definitely discontinued the building of water-cooled engines of 200 horsepower and is concentrating its attention on air-cooled engines in these ratings. For greater horsepower the problem of adequate air-cooling of a larger cylinder has not yet reached complete solution.

Anti-stalling device

THERE was demonstrated recently at Mitchel Field an anti-stalling device which has been officially adopted by the British government for its mail and commercial machines. "Stalling" is the term used to describe the action of an airplane when, with its nose pointed too far upwards, it loses flying speed and control. The result of a stall is very often a dangerous spin. The Savage-Bramson gear is designed to prevent stalling, by giving warning to the pilot that he is approaching the danger point. This it does, when the machine is within four or five miles per hour of the stalling speed, by thrusting the control lever, or "joy stick," forward and leveling out the



Every Shipper who is hunting for Savings in the Cost of doing Business will read this Message

What is Crating Lumber?

THREE items of cost go into every crate or box used by a manufacturer in shipping his goods:

- Lumber to make the crate.
- Labor to make the crate.
- Freight cost on the *weight of the crate*.

In this last item, *freight costs*, there is often a very substantial saving to be made by *more informed choice* of crating lumber.

Here are three instances that illustrate the point. They are taken from the note books of the Weyerhaeuser Crating Engineers. Hundreds of others could be cited. The names of these clients are not cited here but we shall be glad to furnish them on request.

Instance No. 1—Wood formerly used an excellent wood but too heavy for crating light shipments. Crates redesigned using Weyerhaeuser White Pine. Weight saving of 82 pounds on each unit shipped. Average freight rate, \$1.00 per hundred. Money saved by lighter and better crate, 82 cents per unit.

Instance No. 2—Another instance of a light commodity crated with a cheap but far too heavy wood. New crate design recommended using light weight Weyerhaeuser Cedar. The Cedar cost \$6.50 per thousand feet *more* than the wood formerly used. But the freight saving came to \$11.00 per thousand feet.

Net saving, \$4.50 for every thousand feet of lumber used—a total of \$2,700 saving per year.

Instance No. 3—For this heavy export case, Weyerhaeuser Fir and Larch furnished the necessary strength and still saved 210 pounds per case over wood formerly used. Freight rate 96 cents per hundred. Rate of shipment, 25 export cases per day—money saving with Fir and Larch about \$19.00 per day—or \$5,700 per year.

NOW please note: All of the savings noted above were due entirely to the lighter weight of the crating lumber selected in place of the lumber formerly used.

But that is only part of the story. It does not take into account the savings in labor. These Weyerhaeuser Crating Lumber work more easily and with less splitting.

There is also a saving in waste. You buy a uniform grade, all of which is usable.

And beyond that there was in each instance a saving in the quantity of lumber required. Weyerhaeuser Crating Engineers are specialists in crate design. In most instances they can show how to make a better crate with less lumber.

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A shattered wall—but an undented shovel!

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This actual test was undertaken by a company which wanted to prove to themselves the claims of The Wood Shovel & Tool Company. When the test was over, the blade of the shovel was neither bent nor dented.

Wood's Mo-lyb-den-um Shovels will outlast from two to six ordinary shovels. The step or turned over edge makes them comfortable for the feet. The Moly-D handle, which is non-cracking, makes them easy on workmen's hands. They are from six ounces to a pound lighter than ordinary shovels, too.

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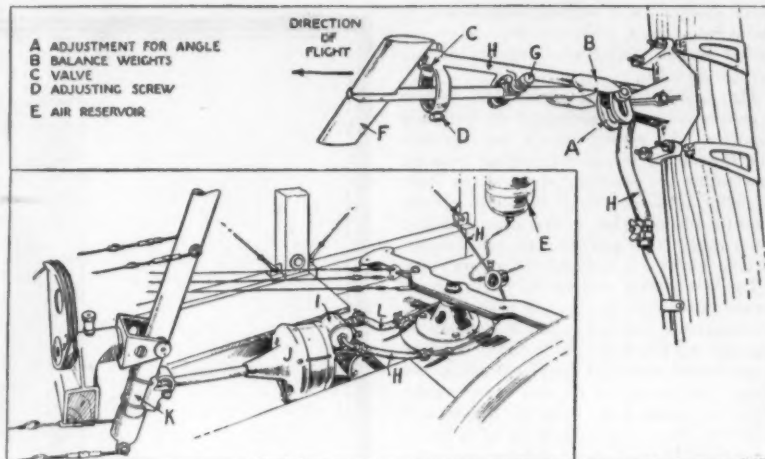
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Steel

The second great improvement
The Step

The third great improvement
"MOLY-D"



Top right: Tripping device on strut. Bottom left: Details of operating mechanism in front of pilot

machine, whereupon it immediately picks up speed.

The device, as shown in our illustration, weighs about five pounds and is operated by the air stream and by compressed air. Upon one of the outer struts is clamped a light

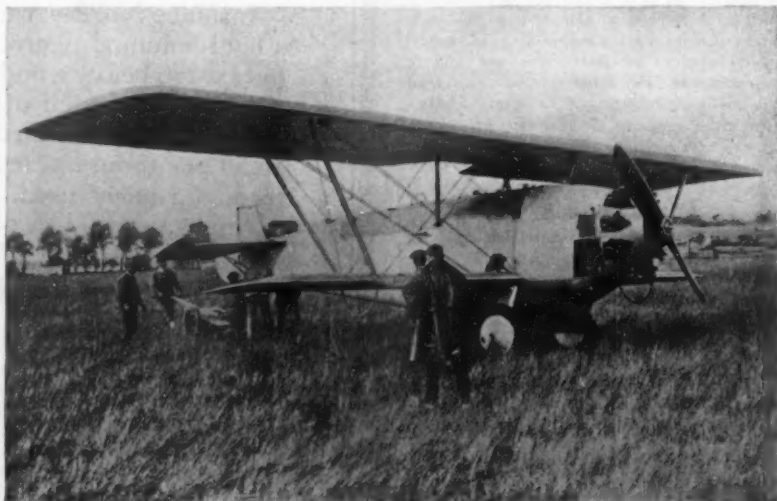
C. The opening of C releases compressed air from the tube H, and this drop of pressure serves in its turn to operate a pilot valve, I, which admits compressed air from a reservoir, E, through a pipe, L, to a cylinder, J. Here it acts on the back of a piston



Anti-stalling device mounted on strut. When the plane approaches the danger point, the aerofoil lifts, operating the mechanism in the fuselage

frame which carries a miniature wing or vane, F. This vane is held horizontally at the end of a rod, which is pivoted at G and carries at its after-end balance weights, B. Normally, the wing rests upon an adjusting screw, D, and the pressure upon the wing is negative; but when the nose of the plane points upward at a dangerous angle, the air stream strikes the bottom of the vane, pushes it up and opens a small valve,

which moves forward and pushes, or tends to push the bottom of the control lever, K, backwards, causing the top of the joy-stick to move forward, thereby depressing the horizontal rudders or elevators and leveling out the machine. The total pressure exerted by the air piston is about 40 pounds; and this is felt by the hand of the pilot as a thrust, tending to pull the stick forward. The pilot thus receives warning that he is



The Petez plane fitted with a 420-horsepower Jupiter motor which will be used by French pilots in the flight from Paris to New York

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$\frac{1}{8}$ h.p. Cast iron frame. Enamel finish. Babbitt bearings, with oil feed. Operates on A.C. or D.C.



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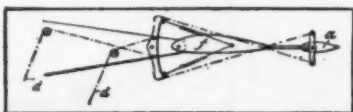
HARPERS MAGAZINE
49 East 33rd Street, New York, N. Y.

approaching the stalling point and he acts accordingly. It will thus be seen that the pilot has only to yield to the pressure on the control lever; but he can control this pressure and is free to execute a loop or other maneuvers if he so wishes. As soon as the plane is at a safe flying angle, the correcting impulse on the control lever ceases.

Experience at the training fields has shown that a large number of the fatal accidents to flying students occur because in an emergency such as engine stoppage, the pupil, instead of pushing the control lever forward seems almost invariably to pull the stick back, shoving the nose of the plane up and stalling it in the air; and it is a fact that even veteran fliers occasionally allow their planes to get into a "stall."

The Flettner Auxiliary Control Surface

ANTON FLETTNER, the inventor of the Rotor Ship, has long been known for the discovery of an auxiliary control for the rudders of ships, which made their operation extremely easy. He has applied this principle to the control surfaces of large air-



Flettner auxiliary control device as applied to the airplane is similar in principle to the extra fin of the Flettner steamship rudder by means of which a child can steer a twelve thousand-ton ship without the intervention of a steam steering engine

planes, by a method which is illustrated diagrammatically in our sketch. The control leads from the pilot's seat, *d* and *d'*, connect to a pivoted arm where their leverage is increased. From this arm wires pass on to the arms of an auxiliary surface *a* which is small relative to the main control surface *f*. The main control surface is pivoted and held in position by the two springs which are light and sufficient to take up the weight of *f* only. When the pilot displaces the auxiliary surface *a* he need exercise only a small effort, but the aerodynamic force on *a* has a tremendous leverage about the pivot point of the surface *f* which therefore responds immediately.

Without servo-motors or other mechanical appliances, such a plan would give ease of control on the largest airplanes or airships.

An Automatic Fire Extinguisher

NOTHING is so terrifying to the aviator as fire, and nothing requires such quick action as its extinction. A French engineer, M. Béchard, has therefore made a real contribution to aviation by perfecting his automatic fire extinguisher. This device is very simple as indicated by our diagram, taken from *L'Illustration*.

"Detectors," consisting of thin metallic tubing wound round and round, are placed under the cowl of the motor wherever a fire is likely to begin. These detectors are filled with gasoline vapor and are connected

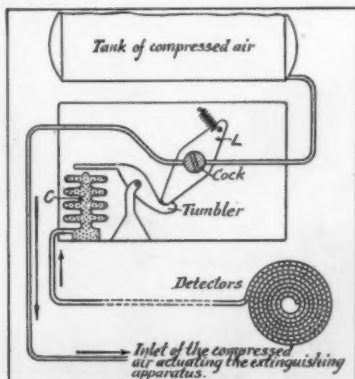


Diagram of Béchard's automatic fire extinguisher

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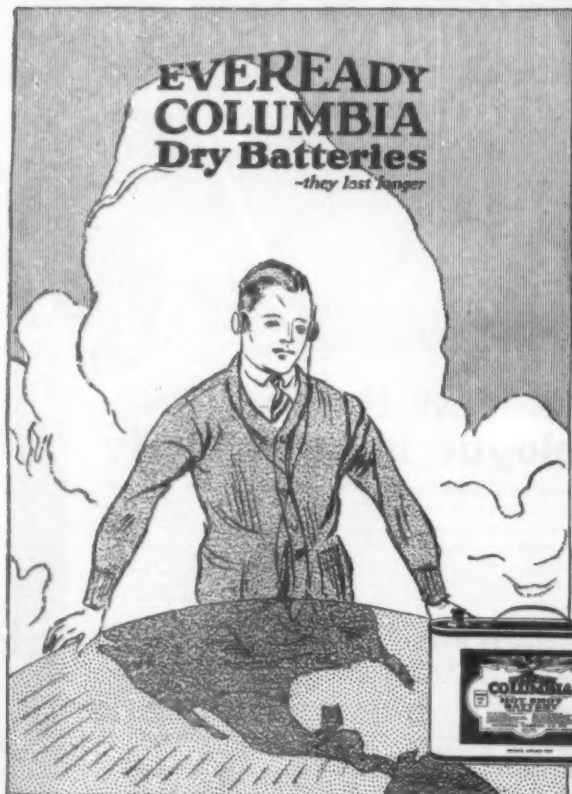
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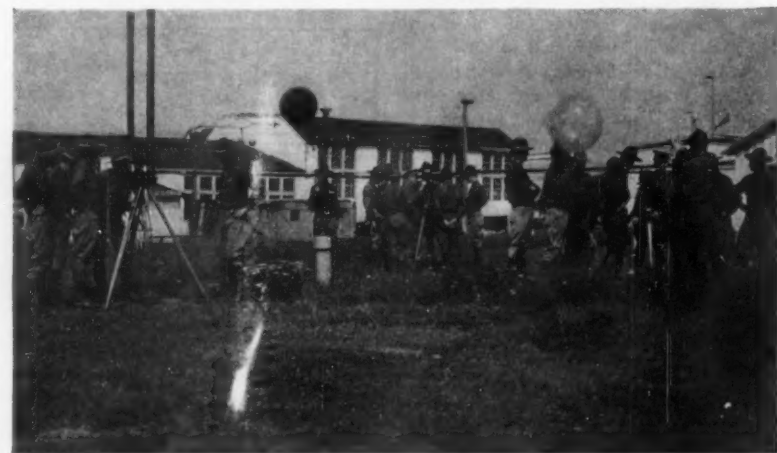
L. Illustration

Beginning of fire started on plane to demonstrate Béchard's fire extinguisher. The device was perfectly effective in five seconds

to a manometric bellows at C, the entire system being absolutely gas tight. If there is any overheating at the point where the detector is placed, the gasoline vapor expands and the bellows C, acting through a trigger, releases the lever L. A strong

Exploring the Upper Air

EVERY morning during typical months of each of the four seasons the curious looking apparatus shown in our photograph is sent up from the Army's experimental station at McCook Field. The balloons,



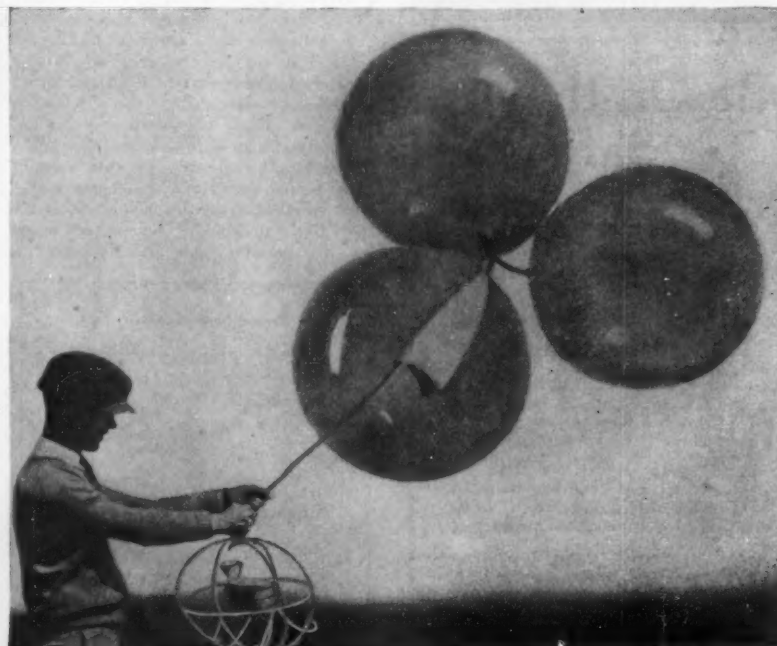
Kaiser & Hebert

Reserve Officers' Training Corps students receiving instruction in meteorology. They are releasing balloons to test the direction and velocity of prevailing winds

spring then moves the lever and thereby opens a valve leading to a tank of compressed air. The compressed air acts immediately on a number of pistons which automatically cut off the gasoline lines, disconnect the magneton, and actuate a powerful fire extinguisher.

M. Béchard recently induced a fire on his plane on purpose, and the automatic device put the fire out in five seconds.

three of them in a cluster, are inflated and weighted. The drum of the meteorograph, which is rotated by clockwork, is carefully smoked. The recording pens of the various instruments carried are carefully adjusted. The instrument is tied in its basket, together with a set of full instructions for its return to the home station after landing. The clock is wound and started, the basket is attached to a small parachute tied to the



Wick World

Balloons, parachutes and wicker cage enclosing meteorograph ready to "take off" for the aerial investigation

balloons, and at a signal the whole device is launched.

The balloons are made of extremely light and extensible fabric; as the balloons rise the pressure of the outer air diminishes and the bags increase to relatively enormous proportions. Finally the limit of yield of the fabric is reached, the balloons burst and the parachute opens up bearing the precious basket safely downwards, to land perhaps in a tree or at the very door of a farmhouse.

Not all the instruments are found, some of them are destroyed by ignorant persons on the ground—one woman carefully washed away the smoked records. No wonder that great excitement prevails at the Meteorological Office of McCook Field when one of the travelers is returned safely home and the instruments are carefully examined.

A Mechanical Landing System

LT. COLONEL UMBERTO NOBILE, a well known Italian engineer, has in-

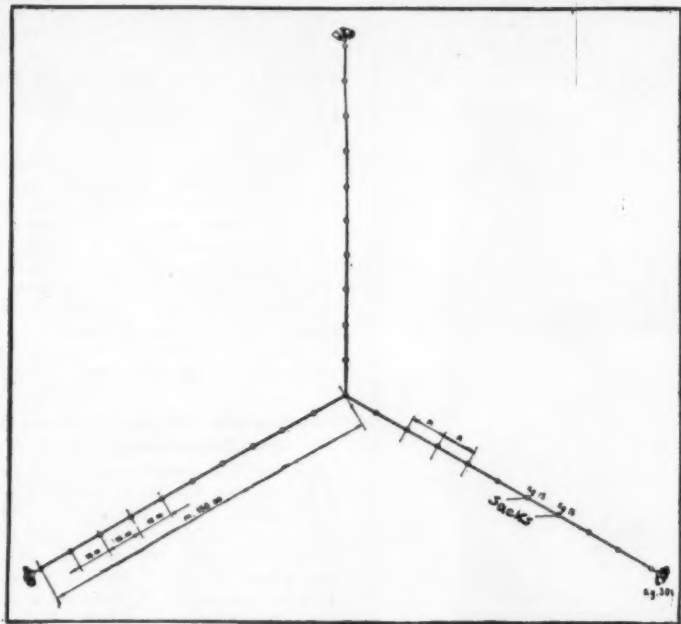


Figure 1: The braking ropes arranged in star form, with heavy sandbags at the tips of the star. The tips are so arranged that there is tension on the ropes

Some of these balloon clusters have made tremendous speed. One landed at Duncansville, Pennsylvania, 297 miles from McCook Field, only two and one-half hours after being launched. One exploration recorded the tremendous cold of 86.9 degrees, Fahrenheit, below zero at an altitude of 32,240 feet.

vented a simple yet effective mechanical landing system for airships which is described in *Aviation*. The device consists essentially of three braking ropes on the ground, and an anchor maneuvered with cable and windlass which are placed in the airship. The braking ropes are disposed on the ground (Figure 1), in a star-shaped

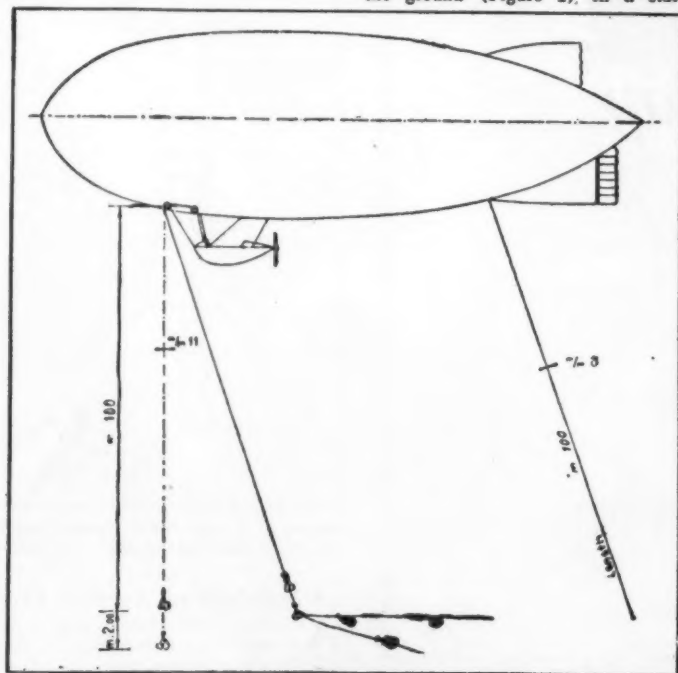


Figure 2: Arrangement of landing cable and anchor at the time of landing

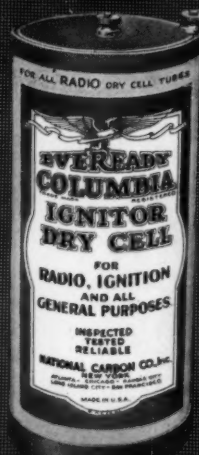
The meteorograph has sailed far higher than any airplane or man-carrying balloon, having reached an altitude of 40,000 feet in one exploration. The records of temperature, pressure and humidity recorded at every point in the upward flight and the indirect deductions as to wind direction obtained assist in making weather forecasts for altitude and long distance flights and will be invaluable to our aviators.

arrangement with heavy sandbags at the tips of the star, placed so far apart that there is a certain amount of tension in the ropes. The cable to which the anchor is attached, passes over a pulley at the bow of the airship, over another pulley further back and is then attached to a manually or mechanically operated windlass, depending on the size of the airship. The general arrangement of cable and anchor is shown in Figure

EVEREADY HOUR EVERY TUESDAY AT 9 P. M.

Eastern Standard Time
For real radio enjoyment, tune in the "Eveready Group," broadcast through stations—

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WCAR	Pittsburgh
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WWJ	Detroit
WCCO	St. Paul
WOC	Davenport
KSD	St. Louis



Eveready Columbia Ignitor "A" Battery, the proven dry cell for all radio dry-cell tubes 1½ volts



No. 764 Portable 22½-volt Vertical Price \$1.75



No. 486 45-volt Layerbuilt Extra-large Vertical Price \$5.50



No. 779 22½-volt Large Vertical Price \$2.00



No. 771 4½-volt "C" Battery Price 60 cents

For radio economy

EVEREADY Radio Batteries are made in different sizes and types so that every radio user can enjoy the economy and convenience to be had by fitting exactly the right Eveready to his receiver. Five of the dry-cell types of Eveready Radio Batteries are here illustrated and described. A dealer near you sells Evereadys.

No. 486. The Eveready Heavy-duty "B" Battery for four or more tubes. The new Layerbuilt construction which gives much greater service. Same size as No. 770.

No. 779. The Eveready "B" Battery for one to three tube sets. Especially adapted for Radiola 25, DeForest D-17 and Operadio receivers. Same capacity as No. 766, and suitable wherever variable taps are not required.

No. 764. The Eveready "B" Battery for portable sets where medium weight and size are permissible.

Eveready Columbia Ignitor Dry Cell Radio "A" Battery for all dry-cell tubes. The dry battery used by vacuum-tube engineers in developing the dry-cell tube.

No. 771. The Eveready "C" Battery. Saves "B" Batteries, improves tone. Price 60 cents.

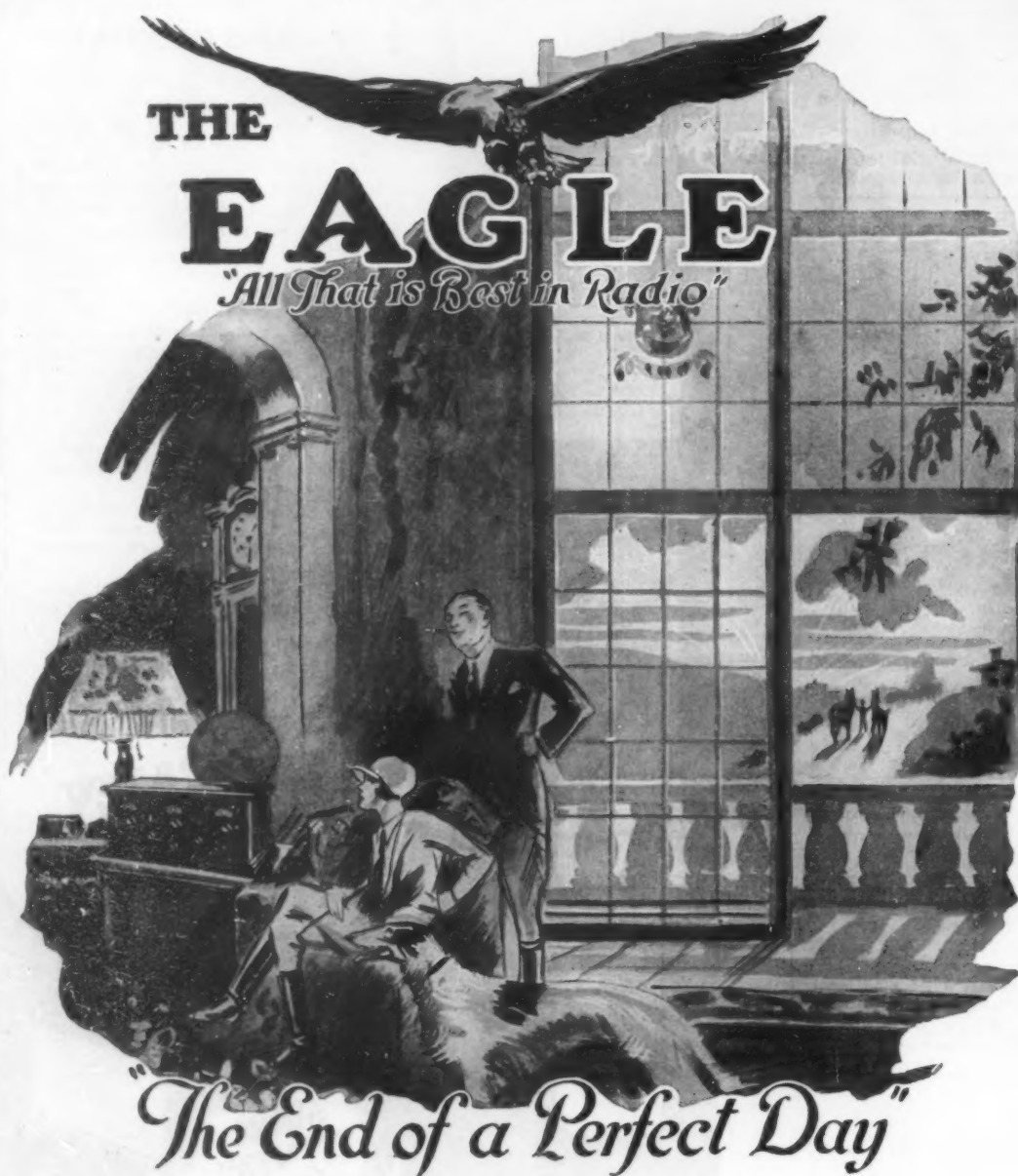
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Radio Batteries

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When the toil of the day is over for Dad, when Mother's cares have stopped for a while, when sister and brother have finished a busy day at play or at school.

What could be more restful in entertaining than an evening with the Eagle Radio?

After a perfect day, the perfect radio brings a fuller enjoyment to the home.

Set shown is the table type. Write for illustrated booklet of console models.

EAGLE RADIO COMPANY

16 Boyden Place



Newark, N. J.

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2 and one of the forms of automatic anchor designed by Colonel Nobile is shown in Figure 3.

The automatic anchor is a simple device: the braking rope in striking against one of the levers closing the hooks of the anchor, overcomes the force of a spring, opens it and gets caught. There are three hooks to the anchor, of comparatively large dimensions and the shank of the anchor is rather short. Otherwise when the shank strikes against the rope the anchor may rebound right over the rope!

The operation of landing with this apparatus is simple. The airship, still with a tendency to climb slightly, is brought approximately over the center of the star-shaped braking ropes, at a height of about 300 feet; the speed of the airship relative to the ground is reduced to a minimum, and the landing cable is rapidly run out until the anchor touches the ground. The landing cable then comes in contact with the braking rope and runs along until the anchor grips the rope. The energy of motion of the airship is rapidly absorbed by the work done in dragging the heavy sandbags over the ground, and by setting the windlass to work, the pilot slowly recovers the landing cable and brings the airship down.

Comparative Depreciation in Aero and Automobile Engines

AN airplane engine worth some \$10,000 only lasts 800 hours, even with several overhauls. Allowing carefully for the cost of overhauling, and for the salvage value of the parts left over, Mr. Black in *Automotive Industries* nevertheless estimates that such an engine depreciates per hour to the expensive tune of \$10.60. This is not quite as bad as would appear at first, since at a cruising speed of 110 miles per hour, the engine would have propelled its plane a distance of 88,000 miles. If the average passenger automobile does 7,500 miles a year, the airplane engine gives at least the equivalent of 12 years of automobile engine service.

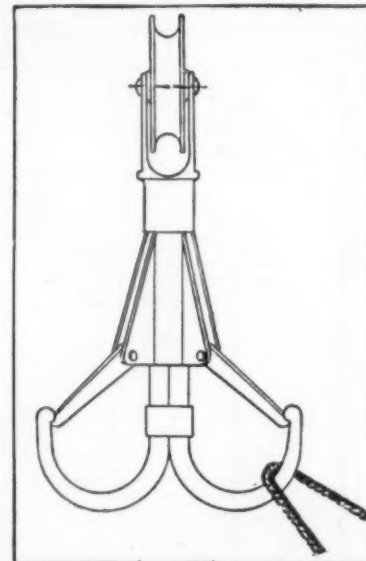


Figure 3. A successful form of anchor in which the braking ropes are caught

A Sailplane of Another Type

"AVIATION" describes a real sailplane developed by John Domenjoz, an old-time French exhibition pilot.

To an ordinary monoplane glider of orthodox construction he has fitted a jib and mainsail and two movable skid fins placed near the wing tips. The machine gains speed on the ground by sailing across the wind as does an ordinary sailboat and the speed thus gained lifts the plane. Towing methods or running down a hill are thus eliminated.

The pilot believes that by proper handling of the sail he can sustain flight without an engine, but in that solution there probably lies a fallacy.

Radio Notes

A Review and Commentary on the Progress in This Branch of Rapid Communication

Conducted by Orrin E. Dunlap, Jr.



Wide World
Lieutenant-Commander F. A. Zeusler, Ice Patrol Officer of the United States Coast Guard, who recently returned from off the Grand Banks of Newfoundland, where vigilance for icebergs was maintained for four months. By means of this short-wave radio receiver on the ice patrol vessels, signals from radio stations in England were heard. This set uses only one tube

New Trends Seen in Broadcasting

The 1925-26 radio season is well under way and it has revealed new tendencies in development which cast some light on the future trend of broadcasting.

Listeners do not seem to care as much about tuning for long distant stations. Radio is being bought more for its entertainment value, and set owners realize a good program from a local transmitter is clearer and more dependable, than a broadcast from a far-away city, because of fading and weak signal strength.

The majority of new receivers are equipped with a sufficient number of tubes to operate a loudspeaker, when receiving a 500-watt station, within a radius of 100 miles under normal atmospheric conditions.

A greater percentage of the new sets require outdoor antennae than indoor wires or loops. The trend is developing, however, toward loop antennae concealed within the radio cabinets.

There is a growing tendency in simplicity of operation, as revealed by the fact that numerous sets this season are tuned by one or two dials, instead of three, the popular number in the past.

Cabinet type and cone loudspeakers are rapidly replacing the long gooseneck horns.

Regenerative and reflex circuits seem to be losing their popularity and tuned radio-frequency sets are gaining in favor along with the superheterodyne.

Receivers which operate directly off the house lighting mains are beginning to appear and they are welcomed by many, because they dispense with batteries, both "A" and "B." This does not mean that manufacturers will stop producing battery sets, because there are millions of homes not wired for electricity. The battery receiver will be popular for a long time to come.

The radio purchaser is getting much more for his money this season than in previous years, providing he buys a reliable manufacturer's wares.

Cabinets are being made much more attractive and are made to harmonize with the furnishings of the home.

The "parts" business and making sets at home has dwindled to almost nothing.

One merchandiser says that over-production will be so great this year that the over-supply in the spring of 1925 will look like a shortage when compared with what is left unsold on the dealers' shelves and in store-houses when April, 1926, arrives.

More of the world's famous artists will be heard on the air this winter, as arrangements have been made to broadcast talent controlled by two leading phonograph companies.

In order to insure the future of the art there is likely to be established a national radio music fund before long, through the cooperation of the leading broadcasting concerns.

It is estimated that 2,000,000 new sets will be sold this season.

Engineers in designing the 1925-26 receivers have paid much more attention to tone quality than heretofore. Selectivity, the ability of a circuit to tune sharply, together with tone quality are more desired now than volume or distant reception.

More stations are becoming toll broadcasters, that is, they are accepting payment for radiating indirect advertising material and publicity. Some contend that that procedure is the answer to the question, "Who will pay for broadcasting?"

Short wavelengths seem destined to play an important part in the future of broadcasting. A boy, in England, with his amateur apparatus played phonograph music for the operator on an American battleship near New Zealand, 14,000 miles distant. This, together with many other remarkable achievements of short waves, seems to indicate great possibilities.

The use of dials as tuning controls is on the wane. A new vertical drum control is employed with the latest receivers for tuning. The surface of the revolving drum fills an opening in the center of the cabinet panel and at each side of the drum are two wheels, the edges of which protrude through the cabinet. Turning the wheels revolves the drum and, as the stations are intercepted, the call letters can be written on the face of the drum. This facilitates finding the stations after the calls are first recorded.

Wired Wireless on Virginian Trains

WIRED wireless is being used on the Virginian Railway to communicate between the front and rear of long freight trains. The course of this railroad lies over the Allegheny and Blue Ridge Mountains. Part of the road operates on a two percent grade with numerous curves and tunnels. This portion of the line has recently been electrified to permit more rapid handling of the

Earn \$50 to \$200 a Week in RADIO

You can! Hundreds of ambitious men are already earning thousands of dollars in this wonderful new industry—you, too, can get your share. Mail coupon below for Free Book which describes fully the amazing money-making opportunities in Radio and tells you how YOU can earn from \$5,000 to over \$10,000 a year.

THE astounding growth of Radio has created thousands of big money opportunities. Millions of dollars were spent during the past year on Radio, and thousands of young men are needed right now to meet the ever-increasing demand of work.

Men are needed to build, sell and install Radio sets—to design, test, repair—as Radio engineers and executives—as operators at land stations and on ships traveling the world over—as operators at the hundreds of broadcasting stations. And these are just a few of the wonderful opportunities.

Easy to Learn Radio at Home in Spare Time

No matter if you know nothing about Radio now, you can quickly become a Radio Expert, by our marvelous new method of practical instruction—instruction which includes all the material for building the latest up-to-date Receiving Sets.

Scores of young men who have taken our course are already earning from \$75 to \$200 a week. Merle Wetzel of Chicago Heights, Ill., advanced from lineman to Radio Engineer, increasing his salary 100% even while taking our course! Emmet Welch, right after finishing his training, started earning \$300 a month and expenses. Another graduate is now an operator of a broadcasting station—PWY of Havana, Cuba—and earns \$250 a month. Still another graduate, only 16 years old, is averaging \$70 a week in a Radio store.

Wonderful Opportunities

Hardly a day goes by without our receiving urgent calls for our graduates. "We need the services of a competent Radio Engineer."

"We want men with executive ability in addition to Radio knowledge to become our local managers."

"We require the services of several resident demonstrators—these are just a few small indications of the great variety of opportunities open to our graduates."

Take advantage of our practical training and the unusual conditions in Radio to step into a big paying position in this wonderful new field. Radio offers you more money than you probably ever dreamed possible—



Doubles Salary

I can very easily make double the amount of money now than before I enrolled with you. Your course has benefited me approximately \$2,000 over and above what I would have earned had I not taken it.

T. WINDER, Grand Junction, Colo.

From \$15 to \$80 a Week

Before I enrolled with you I was making \$15 a week on a farm. Now I earn from \$20 to \$40 a week, and the work is a hundred times easier than before. Since graduating a little over a year ago, I have earned almost \$4,000, and I believe the course will be worth at least \$100.00 to me.

(Signed) GEO. A. ADAMS, Tamaqua, Pa.



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A PAMPHLET explaining "The New Phonetic Type Alphabet" for immediate use on all standard typewriters and linotype machines. Eliminates 13 per cent of unnecessary letters in writing. Can be memorized in an hour. Single copies 50 cents Post Office Money Order. Address (for mail only) F. Vandervoort, European Hotel, Brownsville, Texas, U. S. A.



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Learn more about this tremendous new field and its remarkable opportunities. Learn how you can quickly become a Radio Expert and make big money in Radio.

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EVERY day money is being lost by the continued use of slow and expensive haulage methods.

Suddenly a light dawns. A better haulage method is installed. Extra man power is displaced. Infinitely more material is delivered, and the daily saving astonishes.

No matter what the enterprise or industry, if haulage is a problem, then the Plymouth Gasoline Locomotive is the solution.

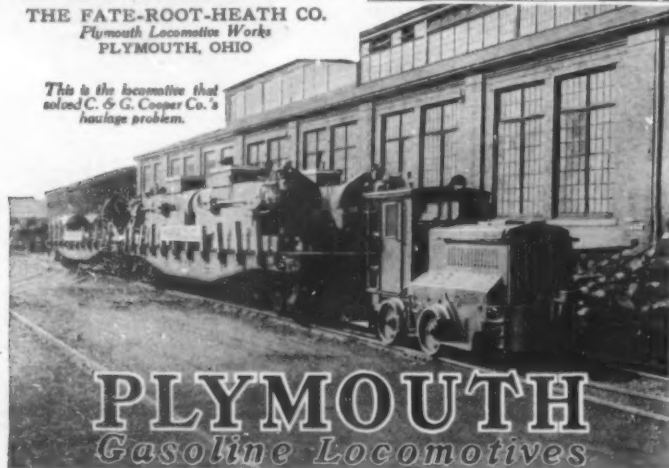
Always ready, no coal or feed to haul, no licensed engineer, no "stand-by" expense, the Plymouth is rapidly displacing the horse, mule and steam dinky as a haulage unit.

Made in 3 to 20 ton sizes, and in any track gauge, to meet every condition.

Write for Catalog and Performance Bulletins.

THE FATE-ROOT-HEATH CO.
Plymouth Locomotive Works
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This is the locomotive that solved C. & G. Cooper Co.'s haulage problem.



THE C. & G. COOPER COMPANY

Mt. Vernon, Ohio, March 18, 1925

The Fate-Root-Heath Co.

Gentlemen:

It is a pleasure to express the satisfaction we have experienced with your seven ton Gasoline Locomotive.

We previously performed all yard switching operations with our 20 and 15 ton Locomotive Cranes. Frankly, somewhat to our surprise, we find that this little giant does everything the Cranes did in the way of motive power in a fraction of the time, hauling and spotting loaded railroad cars with ease and precision, thus releasing our Cranes for the use for which they are intended.

It is practically impossible to estimate the actual saving, but the fact that four or five gallons of gasoline and a quart of oil per day, over rather sharp curves and fair grades, does our work with no coal to shovel nor fire to keep up, really tells the story.

Very truly yours,

THE C. & G. COOPER COMPANY
(Signed) John N. Capron,
Purchasing Agent.

trains on the heavy grade. It is customary on this grade to operate one locomotive at the head of the train and another at the rear. The primary problem has been to synchronous action between the two locomotives, particularly in starting and stopping.

The wired wireless system makes it possible to signal between the engines. The equipment and its operation will be described in an early issue of the Scientific American.

High Power Does Not Overcome Fading

THE last six months have witnessed a ten-fold increase of power used by many of the broadcasting stations. Some of the experimental work has run up as high as 50 kilowatts. Measurements of the actual signals delivered by the high power broadcasters have been made by the Bureau of Standards, Department of Commerce and cooperating laboratories. The observations culminated in special investigations on the alternating 50 and 2½-kilowatt transmission of WGY, Schenectady. The conclusions have been announced by the Bureau of Standards.

"The results are remarkable for some things that did not happen as well as for some that did," says the report. "First and foremost, high power has not resulted in signals of overwhelming intensity. Even the 50-kilowatt transmissions reached many listeners with an intensity which was not noticeably greater than that of many other stations using moderate power. Excessive interference or blanketing of lower power stations is another element of the popular picture of super-power, which has failed to materialize. These results from the viewpoint of scientific investigation, are regarded as important verification of the calculations of radio engineers, who have consistently maintained that the apprehensions of stifling effects of high power were wholly unfounded.

"The most startling conclusions are in reference to fading, or signal fluctuation. At all distances greater than 50 miles from a station actual tests showed that the received wave intensity is continuously fluctuating, the variation from maximum to minimum being as great as 100 to 1. The ear is notoriously insensitive to intensity changes, otherwise the reception of distant stations would be quite unacceptable. Increasing power was found to effect no improvement in the degree of fluctuation. It can therefore be definitely stated that high power is not the solution for the fading problem.

"For still another reason, the distance over which a broadcasting station gives highly satisfactory, dependable service is quite limited. This is the omnipresent background of static and all sorts of electrical disturbances, which requires that the radio wave have more than a certain minimum intensity in order to assure reception free from interference. There is an area around every broadcast station within which such perfect reception is assured and beyond which it is not possible to rely on night-time reception free from disturbances. Day-time reception is in general not possible at all beyond this area. This zone of really dependable radio service around each broadcasting station is surprisingly small, but its area is approximately proportional to the transmitter's power. This is found to be the prime reason which makes high power even desirable from the standpoint of improved public reception."

A Large Audience

It is estimated that 43 percent of the country's population is reached within a 100-mile radius of WEA and eleven stations linked by land wires with the Broadway transmitter. About one farmer in forty has a radio receiver, according to a survey made by the Capper Farm Publications.

Hopes to Log 300 Stations

HAL H. SMITH, whose novel wave-trap arrangement, which increased the range of his Radiola superheterodyne, was described in the September issue of the Scientific American, writes: "My total number of stations is now 204. I heard KGO, Oakland, here in Washington during the summer. My outdoor antenna is 75 feet long. I would like to run up the total to 300 before May, 1926, making a total of 300 stations heard in two years."

What to Expect From High Power

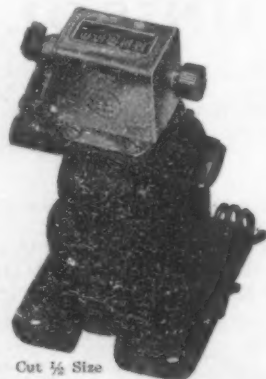
WITHIN five miles of a super-power broadcasting station, that is, a transmitter rated with an output of 50 kilowatts or higher, it requires a highly selective receiver to get distant 500-watt stations, through the signals of the super-plant, is the estimate of Dr. A. N. Goldsmith. Receivers having three good stages of tuned radio-frequency amplification or a superheterodyne will get the distant signals unless the wavelengths of the superstation and distant transmitter are too close. Reception of 500-watt stations, not more than ten miles away, or of a 5-kilowatt station at a greater distance, should be

Wires In Reports from Machines

From machines in the shop to the dial over your desk, production-records come in—via this Veeder Magnetic Counter. Installed in your office, it indicates work being done by the man and machine out in the factory. Instant reports—close supervision—from any distance that wires connect with this

Veeder COUNTER

The "Form U" Magnetic Counter below counts machine operations or units of output, electrically communicated.



Cut ½ Size

NEW MAGNETIC

Mechanical contacts on your machine make and break the electrical circuit which operates the counter. The electro-magnetic drive can get its current from your regular lighting circuit: Direct current, 110 Volts.

For machines, devices or apparatus where you can't put on a mechanically operated counter, you readily attach a contact-maker and get your count "over the wires."

"Form U" and larger Magnetic Counters are fully described in a special bulletin. Write for copy—along with the full-line Counter Catalogue.

The Veeder Mfg. Co., 18 Sargeant St.
Hartford, Conn.



J. W. Holland (2-DS, Brooklyn, N. Y.), with the apparatus with which he held nightly two-way conversations with the MacMillan arctic expedition. At his left is the receiving set which picked up the communications. It is a three-circuit regenerative set of special construction, which works on a wave band of from 10 to 200 meters. The base of the vacuum tube, used as a detector, had to be taken off to minimize capacity and the coils are wound on air, various sizes being used for different wavelengths. The transmitter is rated at 100 watts. It is tuned to the 40-meter wave



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A note of genuine enthusiasm and appreciation colors the phrase "Just What I Wanted" when the gift in question is a NICHOLSON File.

From helping Dad keep the car in shape to sharpening Brother's jack-knife, a thousand and one uses make NICHOLSON Files appropriate gifts for nearly every member of the family.

Take your Christmas gift list to your hardware dealer. He will help you select the right file for each purpose.

NICHOLSON Files are tested repeatedly before they leave the factory. They are mechanically perfect and cut clean from the very first stroke.

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easily possible. A high-grade wave trap added to the average receiver within the five-mile radius of a super-broadcaster will aid materially in eliminating interference.

In a zone from 5 to 100 miles from a super-station the service should be ideal, with a reliable, loud, clear signal and no serious interference, says Dr. Goldsmith.

A listener 100 to 200 miles from a 50-kilowatt transmitter will get excellent service except on evenings when fading is severe. The signal strength will correspond to a 500-watt station ten miles away.

The receiver 200 to 500 miles from the super-broadcaster will get fairly good service with only moderate fading. Beyond 500 miles the signals from a 50-kilowatt station will not have sufficient strength to consistently overcome all disturbances, although enormous "freak" ranges may be obtained.



Kadai & Herbert

Close-up of Mr. Holland's receiving set (shown on preceding page) used to pick up the MacMillan communications

Code of Ethics for Broadcasters

THE Chicago Broadcasters' Association has launched a movement to establish high standards in the conduct of broadcasting stations. A code of ethics, based on the principle that broadcasting is a public service, is under consideration by the association. The code sets forth the declaration that the stations believe it their duty:

"To consider the vocation of broadcasting as affording a distinct opportunity to serve society.

"To realize that a broadcasting station is ambitious to succeed, but that it is first an ethical enterprise and wishes no success that is not founded on the highest justice and morality.

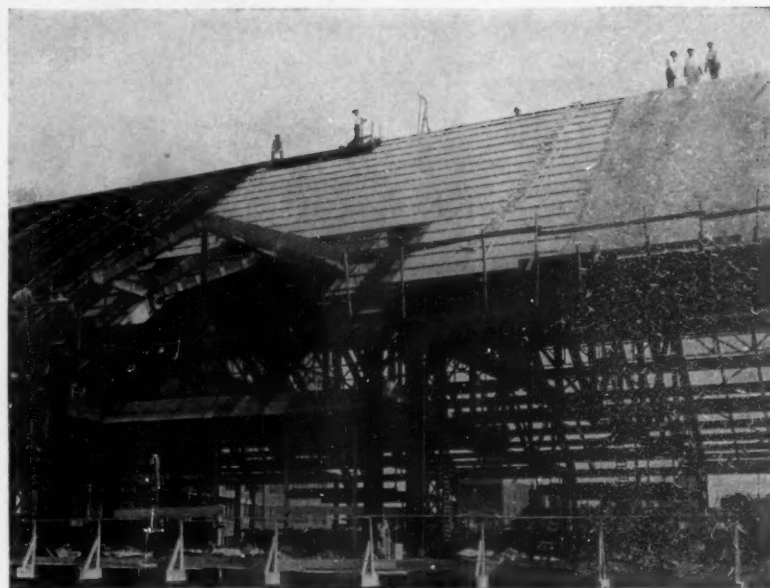
"To believe in the universalness of the golden rule.

"To realize that in the consideration of general problems, progressive radio broadcasting as a whole must be served rather than a selfish interest of individual stations."

The code proposes that each member pledge loyalty to the association to cooperate with other stations and to be "just, fair and generous in all dealings with other members and the public."

Laws Govern Over-Street Antennas

LONDON has taken a definite stand relative to a private individual stretching an antenna over a public street. In London wires over the streets must be licensed by the London County Council, and they must be at least thirty-five feet above the ground and six feet above any building they cross. Outside of London no public body has the power to license cross-street antennas in this way. A municipal council may pass by-laws regarding the erecting of antennas but, if such laws have not been passed, the local council has no power to interfere in the matter unless the wire is so low that it becomes an obstruction to traffic. If a radio wire across a street or otherwise is considered dangerous to the public, the city



Here's the new fireproof top on Madison Square Gardens

In rebuilding Madison Square Gardens—long the mecca of America's sport lovers—every provision was made for fire safety, comfort and permanence.

In the roof, for instance, they used 50,000 square feet of Sheetrock-Pyrofill construction (Sheetrock laid on light rails and covered with three inches of poured gypsum as pictured above).

Besides being absolutely fireproof this roof deck is a splendid heat insulator. Also assures a trim attractive undersurface. And its light weight effects worth-while savings in roof framing and supporting members.

You will find Sheetrock-Pyrofill roof decks equally satisfactory, equally economical for industrial buildings, schools, auditoriums, hotels, theatres, and hospitals. Mail coupon for booklet fully describing this modern fireproof construction.

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council retains the arbitrary right to order the antenna removed.

In most American cities it is necessary to obtain permission from the city officials before a radio antenna can be erected across a public highway.

Woodshed Better Than Laboratory

C. FRANCIS JENKINS, the Washington experimenter who has demonstrated the broadcasting of motion pictures, says that there are many details yet to be worked out, before movies can be sent through the air to millions of homes as concerts are today. He says it is not necessary to have a fine research laboratory to perfect radio movies, but a woodshed is much better. He recently said, "If you have a laboratory and no woodshed, where you can get off by yourself and think clearly, you are out of luck. If you have a woodshed, go to it, and good luck to you. If your woodshed is on a farm, the probability of correct thinking is greatly enhanced."

To Radio Voices of the Dead

THE British Broadcasting Company and the British Museum have made an arrangement whereby some of the phonograph records of famous voices will be broadcast. The tentative lists includes Tennyson, Sir Herbert Tree's record of Hamlet's soliloquy on death, and Roosevelt's speech against the trusts, which is said to have the real Roosevelt "punch." It was hoped that a record made by Queen Victoria could be put on the air but this was decided against because the words were registered on an old cylinder, which does not give a true idea of her voice.

Broadcast impresarios point out that reproduction of the voices of famous persons over the radio opens interesting possibilities for appropriate broadcasts of anniversary celebrations.

Shields Improve the Neutrodyne

A RADICAL change in the design of a neutrodyne circuit has been introduced by the Stromberg-Carlson Telephone Manufacturing Company, in its 1925-26 model, recently placed on the market. All three radio-frequency amplifying stages are heavily shielded, making four protected compartments. The shields enclose all of the tuning coils, condensers, tube sockets and fixed condensers used between the antenna and the first audio amplifier. The radio-amplifier tubes and detector are completely enclosed within the shields, removable covers being provided in each shield, allowing tubes to

be inserted and removed without disturbing the shield casings. The upper structures of the shields are made of heavy sheet copper.

It is claimed that this shielding enhances distance ability, selectivity, tone quality and protects the instruments from dust and dampness.

Some Prefer Outdoor Antennas

A DESIGNER of one of the new receivers this season gave his reasons for using an outdoor antenna in place of a loop, as follows: The outdoor antenna is non-directional, therefore it does not require additional controls for tuning, as for a loop antenna. The outdoor wire has greater pick-up ability than a small loop or coil antenna, therefore the distance range of the receiver is not limited. Some engineers estimate that a good outdoor antenna is the equivalent of two tubes as far as distance and volume are concerned.

Another advantage attributed to the outdoor wire is that it avoids the necessity of a revolving framework of a loop adjacent to the table-type receiver and allows for a more compact and neater design of floor-type cabinet.

Transformers Designed for Various Tubes

To obtain maximum efficiency in a receiver using radio-frequency amplification, it is important that the transformers be designed for the particular type of tubes used in the circuit. This statement has been justified by the result of tests made in the laboratory of the All-American Radio Corporation. The engineers point out that if a receiver is using dry-cell tubes, with proper transformers, and is changed to the storage-battery type tubes, it will be necessary to change the radio-frequency amplifying transformers if equally efficient results are to be obtained.

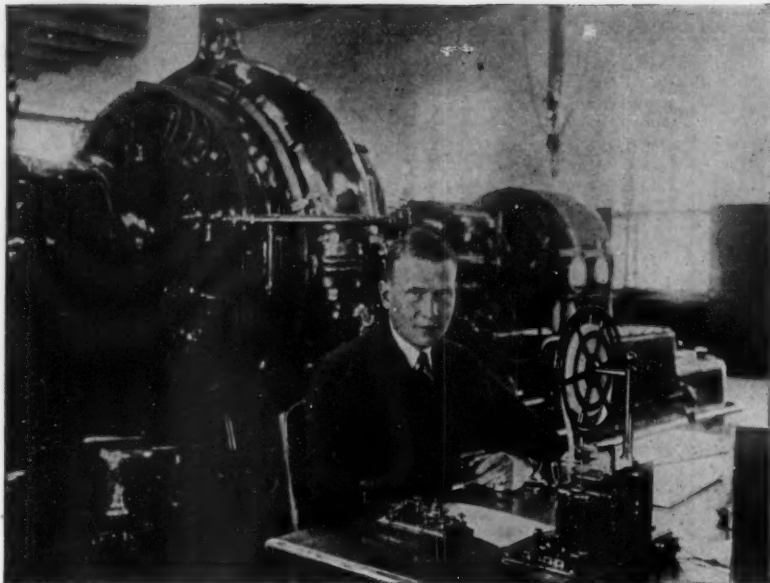
This is made necessary by the fact that the characteristics of the tubes vary according to their internal construction. In the dry-cell type of tube the elements are very close together, making it possible and advantageous to use more wire on the primary of the transformer. The tendency of a vacuum tube having a tuned input circuit to oscillate, is proportional to the inductive load or the number of turns of wire on the primary of the transformer in the plate circuit.

If dry-cell tubes are replaced by tubes of the storage-battery type, the circuit is likely to become unstable and will oscillate readily, due to the difference in construction of the elements in the tubes, unless the trans-



Kadai & Hartley

A novel radio set was entered in the contest for amateur set builders held at the Second Annual Radio World's Fair by John J. Muller. It looks like a typewriter. To tune in a station on this set, a button is pressed which actuates electric magnets which, in turn, cut in portions of the tuning coil. Thus, if one wants to listen in on WEAf, he presses the button marked WEAf and the coil will be tuned automatically for the wave-length of that station. Each station has an electric button. The rows of these tuning buttons can be plainly seen in the photograph. Jack Hartley is demonstrating how it works.



Kadel & Herbert

An interior view of the Swedish high power radio station at Grimeton, which now spans the Atlantic. It is built according to the system invented by Ernst F. W. Alexanderson. The station has been financed partly by the Swedish government and partly by American capital.

formers are changed. When the tube characteristics are matched up with the correct amount of wire on the primary of the transformer, then the circuit will cover the broadcast wave band evenly and with good amplification.

The core of a radio-frequency transformer is generally filled with finely powdered iron, in order to broaden tuning so that the transformer can be used over a desired wave band without the need of a variable condenser for tuning. The powdered iron is used in preference to the usual laminated sheets of iron, because there are fewer eddy current losses and closer contact between core and winding is obtained.

Paper Cone Does Not Reproduce Sound

THE paper cone of the disk loudspeakers does not produce the music, because paper has such a low frequency it is useless in loudspeaker production unless it is attached to a proper electrical unit, designed for the specific purpose of voice and music reproduction.

New Transmitter Tube

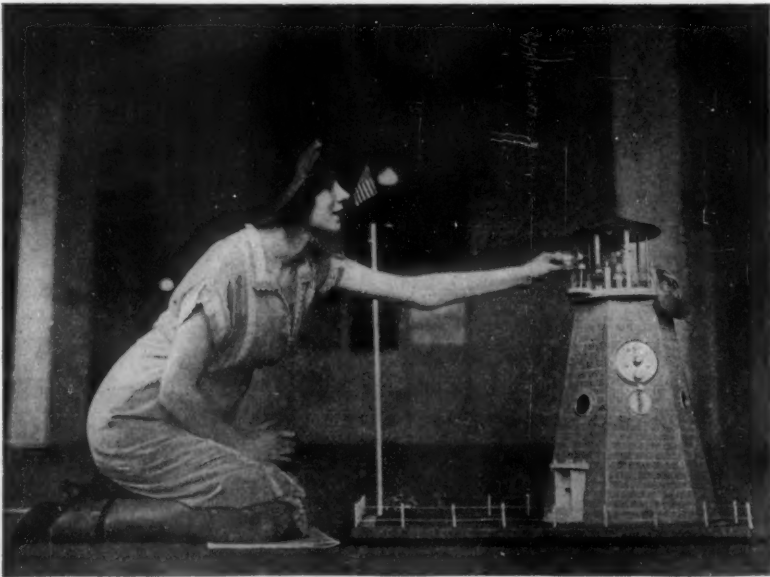
A NEW vacuum tube for amateur transmitting purposes has been developed by the DeForest Radio Company. It is called the "H" tube. The tube will oscillate on all plate voltages from 750 to 5,000. However,

3,000 volts is recommended as the limit for general use unless special precautions are taken to prevent the tube from seriously overheating. Specifications of the tube are as follows: Plate voltage, 750 to 3,000; grid bias, 50 to 500 volts; filament voltage, 10; filament amperage, 2.75; plate current up to 1,600 volts, 110 milliamperes; maximum output in watts, 250; maximum safe plate dissipation in watts, 170; grid leak value, when used in a circuit of the Hartley type, 10,000 to 100,000 ohms.

A Batteryless Set

THE Miessner Radio Corporation has placed a new batteryless receiver on the market. It was developed by B. F. Miessner, president of the concern. A current conversion device is placed in the same cabinet and alongside the radio instruments. Six ordinary vacuum tubes perform the function of current conversion, detection and amplification. The loudspeaker is embodied within the cabinet, making the entire unit complete in itself. The circuit is tuned by four dials and the operating cost is said to be less than the cost of operating an electric iron. The power for operation can be obtained from any light socket connected to a 60-cycle, 110-volt line. A hum eliminator is provided, so that any hum caused by the alternating current can be

(Continued on page 427)



Kadel & Herbert

A novel three-tube radio set is built in the form of a lighthouse. The detector is mounted in the glass enclosure at the top and the two-stage amplifier is inside



Not Touched in Twenty-Two Years!

"When you can put bearings on your countershafts and run them for twenty-two years—as Argutos have done for me—with no sign of wear to shaft or bearing, or a drop of oil applied during that time—you are getting pretty nearly 100% efficiency."

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How would it feel really to enjoy Christmas this year?

Do you remember last Christmas Eve—wasn't it dreadful? You in a frenzy, buying four-in-hands for nephews who wear only bow ties, and warm bed jackets for aunts who spend every winter in Florida—and ending up with a ghastly headache—and being in a frightful temper, practically kicking the cat out of the room?

Why not, this year, dispense with all last minute shopping and give yourself the luxury of a leisurely, unharassed (and unharassing) merry Christmas, incidentally giving your friends what they will like above all things.

We are not making extravagant claims for Harpers Magazine as the perfect universal Christmas gift. Several on your list, frankly, won't be interested in it.

Ingeborg, the new laundress will doubtless get more real comfort out of a serviceable blouse; the baby is a little young for some of the articles—especially Rebecca West; and Fido would only worry it and make a mess. BUT, the great majority will find more to amuse and enliven them in 12 monthly visits of Harpers than in any other gift you could present.

Your father will find food for thought in the unconventional, clear sighted discussions on American life by Duncan Aikman, Charles Merz, Bertrand Russell. Aunt Valerie, that lady of dazzling clothes and sparkling conversation, confesses that like all of the smart people she knows, she is finding the new Harpers indispensable for the sophisticated, enquiring mind.

For Kenneth, one of the younger intellectuals, it is the obvious choice. Likewise, for Honoria. These two follow, with lively comment, the stories of Christopher Morley, Aldous Huxley, Van Loon, and the poetry of Edna St. Vincent Millay.

Moreover, there are countless features which are absorbing to all; Dr. Fosdick's monthly department, "Religion and life," the finest fiction from America and England, points of view from and about Europe, and brilliant biography and history.

Five minutes spent right now at your desk, and the major part of your Christmas shopping is done, the gifts all wrapped and mailed—a not inconsiderable item! And to make it even easier, we are giving a special holiday price of \$3.00 for every gift subscription, if you order more than one. Otherwise, the usual rate of \$4.00 a year holds. Send us the coupon below, and we will enter the subscriptions to begin at the proper time. Moreover, we send a cheerful Christmas card with your good wishes to your friends to announce the magazine's arrival.

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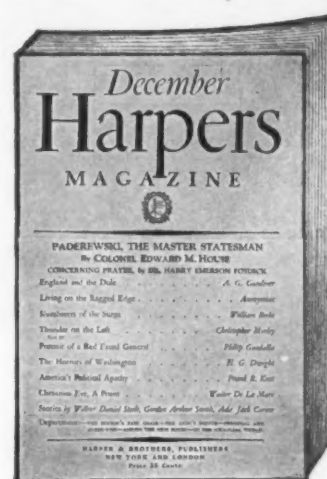
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The New Harpers Magazine is Established!

From the moment its vivid cover first appeared, the new Harpers has been phenomenally successful.

As the first number—September—disappeared with gratifying rapidity from the newsstands, hundreds of letters, spontaneous and enthusiastic, flooded the editorial offices.

In all this wave of warm generous praise, there was only one note of qualification—in itself flattering. More than one admirer wrote, "It's the best number of any magazine I've ever seen. . . but. . . how will you ever keep up this pace?"

Then the October number appeared—and the November, more than fulfilling the bright promise of September, and dispelling definitely and finally that solitary doubt. And the doubters were writing, "You've done it! You're getting out numbers each one better than the last."

Meanwhile the newsstands sales and new subscriptions continue to mount. And in all circles where educated Americans gather, where talk is spirited and fearless, Harpers Magazine is once more acclaimed as the leading magazine of American thought.

THE DECEMBER NUMBER CONTAINS

PADEREWSKI, THE MASTER STATESMAN
by Colonel Edward M. House

CONCERNING PRAYER
by Dr. Harry E. Fosdick

ENGLAND AND THE DOLE
by A. G. Gardiner

LIVING ON THE RAGGED EDGE
Anonymous

SLUMBERERS OF THE SURGE
by William Beebe

THUNDER ON THE LEFT, PART IV
by Christopher Morley

PORTRAIT OF A RED FACED GENERAL
by Philip Guedalla

THE HORRORS OF WASHINGTON
by H. G. Dwight

AMERICA'S POLITICAL APATHY
by Frank R. Kent

CHRISTMAS EVE
by Walter de la Mare

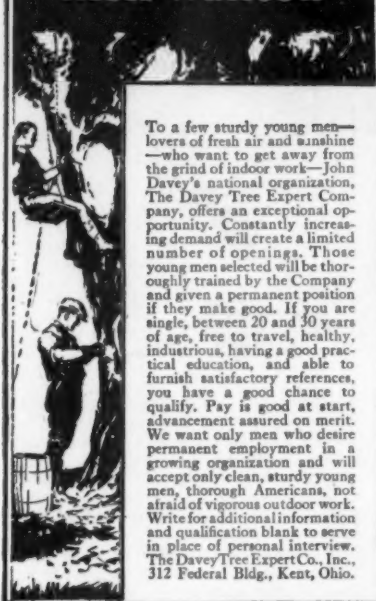
STORIES: Wilbur Daniel Steele, Gordon Arthur Smith, Ada Jack Carver

DEPARTMENTS: The Editor's Easy Chair—The Lion's Mouth—Personal and Otherwise Among the New Books—In the Financial World.

Harpers

MAGAZINE

Young outdoor men wanted



To a few sturdy young men—lovers of fresh air and sunshine—who want to get away from the grind of indoor work—John Davey's national organization, The Davey Tree Expert Company, offers an exceptional opportunity. Constantly increasing demand will create a limited number of openings. Those young men selected will be thoroughly trained by the Company and given a permanent position if they make good. If you are single, between 20 and 30 years of age, free to travel, healthy, industrious, having a good practical education, and able to furnish satisfactory references, you have a good chance to qualify. Pay is good at start, advancement assured on merit. We want only men who desire permanent employment in a growing organization and will accept only clean, sturdy young men, thorough Americans, not afraid of vigorous outdoor work. Write for additional information and qualification blank to serve in place of personal interview. The Davey Tree Expert Co., Inc., 312 Federal Bldg., Kent, Ohio.

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stopped by regulating this control. Once adjusted for a particular type of tube no further regulation is required, unless the tubes are changed.

British Plans for Super-power Broadcasts

THE British plan to entertain America this winter by means of super-power broadcasts from their new station at Daventry, England. The programs will be recorded in advance of the broadcasting, on a radio-film or steel band, in order to overcome the difficulties encountered because of the difference in time between London and this country. At the time of day New York stations radiate their best entertainment, in the evening, English listeners are already fast asleep. One o'clock in the morning is late in London, and the class of people who make up the British radio public are obliged, because of circumstances of their life, to go to bed early. When it is eight



Stewart C. Whitman demonstrates his new aerial. It serves also as a tuning unit. It tunes the incoming wave signals to the peak of the wave desired and it calibrates all dial readings and holds them uniform and constant. Signals can be tuned in with the dials and by sharpening with the loop volume will be increased from 25 to 50 percent

o'clock in London, Americans are still in their offices and schools, therefore, it will be necessary to make records of the broadcasts and send them across the sea while the Britons sleep.

Plan to Standardize Radio Apparatus

THE Standards Committee of the Radio Manufacturers' Association is going ahead with its plans to work out standards which will protect the radio public. As soon as these standards are determined they will be given to the public and members of the association will label their products "RMA Standard." This will mean that the buyer will always be protected when he pays his money for apparatus bearing the RMA stamp.

The association is working on a plan to bring all branches of radio into a central organization. This central body would represent the manufacturers, jobbers, dealers, broadcasters, trade papers, listeners' organizations and agricultural interests.

Outdoor Antennas to Disappear Entirely

THE outdoor antenna will entirely disappear and will be replaced by loops, which will decrease in size from year to year as the art of developing sensitivity in a receiver increases, according to W. H. Priess, president of the Priess Radio Corporation. He ventures the opinion that the homes of the future will have built-in radio equipment, consisting of concealed loudspeaker outlets in various rooms, so installed that the music can be directed to any room at will.



Safeguarding the lanes of speech

The New York-Chicago telephone cable has been completed and is now in service. A triumph of American telephone engineering, the new cable is the result of years of research and cost \$25,000,000 to construct. Its first reach extended along the Atlantic seaboard, then steadily westward until this last long section to Chicago was put into service.

To the public, this cable means dependable service irrespective of weather conditions. It is now not likely that sleet storms, which at times interfere with the open wire type of construction with 40 to 50 wires on a pole, will again cut off the rest of the nation from New York or from the nation's capital as did the heavy sleet storm on the day of President Taft's inauguration.

The new cable means speedier service, as it provides numerous additional telephone circuits and will carry a multitude of telephone and telegraph messages. It would take ten lines of poles, each heavily loaded with wires, to carry the circuits contained in this most modern artery of speech.

This cable, important as it is, is only one of the Bell System projects that make up its national program for better telephone service to the subscriber. It is another illustration of the System's intention to provide the public with speedier and even more dependable service.



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Will the Flames Spread?

The irrepressible longing of people to govern themselves is burning into flame all over the Orient.

China is ablaze. China is demanding complete freedom from white race domination. If it cannot win by peace and justice, it will by boycott and—if necessary—war. Remember what Napoleon said: "When China moves, she will move the world!"

India is demanding independence. Perhaps it will be satisfied with home rule under Britain. But nothing less!

The Riff will fight France and Spain—to its last man—for freedom. This insignificant race is testing French military power almost to the limit!

Turkey has forced complete independence from the white man—and is ready to fight any great Western Power that interferes.

Persia has thrown off the influence of England and Russia.

Sooner or later every important native race under white control will follow suit. The East outnumbers the West three to one.

Is the situation ominous? Does it mean anything to you? Do you want to know how the white races can successfully face the issue?

ASIA Magazine (richly illustrated) will tell you the truth about the Orient.

ASIA MAGAZINE is:

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ROMANCE and MYSTERY. Still alive where the East is calling.

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NATURE. Great animals stalk out of their jungle haunts into the pages of ASIA.

KNOWLEDGE and CULTURE. You must stay tongue-tied among the best people if you do not know the Orient these days.

EXPLORATION. Roy Chapman Andrews has cabled that his new series on his adventures in Mongolia is on its way across the Pacific.

Read one issue of ASIA. Then see if you do not have new facts for conversation and thought that will distinguish you among your friends. ASIA readers—on the inside of the world's most vital trends long before the general public understands—have something new and rare to offer wherever men and women gather.

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This "holy man" of India—reclining on a bed of nails—may look ridiculous to you. But India, with thirty centuries of history, does know religion as a fundamental of human life. That is something for Americans to think about!

Contents of December ASIA

PUBLIC OPINION IN CHINA—does it exist? Is it responsible? How will it mould future events? A brilliant Chinese educator analyzes the present situation in China with discerning eyes.

BUDDHIST SPINXES IN A MOSLEM LAND links together a fifth-century Chinese pilgrim, Marco Polo and French archeologists of today in recent adventures and discoveries in "Forbidden Afghanistan."

EYE TO EYE WITH RAISULI—a memorable interview between Vincent Sheean and the notorious Barbary pirate, just after his capture by Abd el-Krim—is a fascinating Moroccan chapter in this number of ASIA.

MOTHERED BABIES OF THE ORIENT, a charming pictorial, touches the most human sentiment in the world.

PEKING CLANGOR, all the haunting melody of the thousand street-criers of Peking, the din of a million drums and rattles and horns and strident calls to attention, live in the pages of this vivid little article.

"FA'A-SAMOA"—Samoa tradition, the Samoan way of looking at life and doing things—exasperating at times, funny at times, heart-breaking at times, inspiring at times! But in spite of all the obstacles, as this article shows, the Flahertys succeeded in making a film of this same strange, fast-disappearing "fa'a-Samoa" life.

DEVIL-DANCES AMID THE ETERNAL SNOWS describes an age-old religious ceremony of those most mysterious of people—the Tibetan lamas.

STEPHEN GIRARD—MARINER AND MERCHANT—recounts the story of a famous "early Philadelphia" and shows how the China and East India trade of a hundred years ago were behind the Girard fortune.

"THE ETERNAL WOMANLY" reveals the answer of Indian women to an American woman's searching questions regarding the riddle of the free soul.

IN THE EDITOR'S MAIL



An Excellent Suggestion

Mr. Slauson's articles on motor traffic have brought forth a lively response from many readers. An excellent suggestion comes from one of our Canadian readers. We "second the motion" for a better locomotive whistle, and submit this letter for your vote on the subject.

Dear Mr. Munn:

I was very much interested in the article by H. W. Slauson, M.E., in your August issue, on auto accidents and more particularly those at grade crossings.

Much has been written on this subject and in all, or nearly all, the motor driver is accused of trying to beat the train or of gross carelessness. I have driven a car for many years, in fact am one of the oldest drivers here and was in the railroad business for many years. I have a great deal of sympathy for the engine driver and know what is expected of him and that he has the right of way.

I do not think that any motor driver deliberately tries to beat the train, but that he does not realize that the train is traveling about twice as fast as he thinks it is and that, therefore, he has lots of time. Most accidents at crossings occur to people who are not familiar with the locality and hence do not know how many railroads there are near them.

When the whistle sounds it is almost impossible to locate the train, especially if one is driving a closed car or a wind is blowing in an opposite direction. The train and auto are probably covering from sixty to one hundred feet per second, so it does not take long for both to reach the crossing. In many cases the motorist must decide quickly, faster than his brain can work, whether it is safer to step on the gas or to apply the brakes, either of which might be fatal.

Why do not the railroads take a lesson from automobile makers and adopt

something like their horn which is placed in front of the car where it is needed and not up in the air as is that of the locomotive, the sound from which goes anywhere. This could be worked by compressed air, electrically or a different whistle might be worked out by locomotive engineers.

When we use a megaphone we do not point it to the clouds but in the direction of the person we are trying to reach.

I am no speed artist and my eyesight and hearing are of the best, but I was nearly killed once by one of our own engines because it was running about twice as fast as I thought. I learned something.

The number of accidents at grade crossings is appalling and on the increase. From my own experience I feel sure that the motorist does not know that he is in danger until it is too late, then he gets rattled and is liable to do anything.

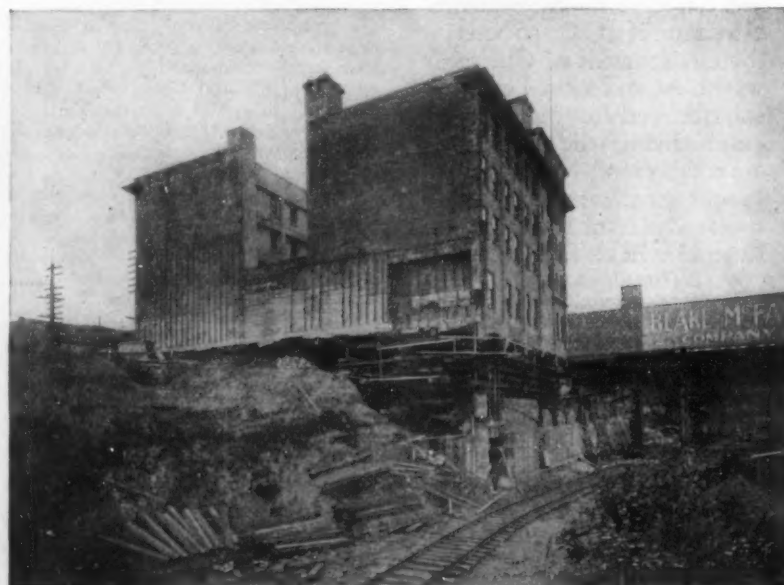
O. J. Booth.

Engineers Will Tackle Anything

"The hotel that 'took up its beds and walked!'" That is how one of our readers describes an engineering undertaking in Portland, Oregon, when the Princess Hotel was moved intact. Perhaps the accompanying photograph doesn't look particularly conducive to sleep, but the operation was performed in an interesting manner, as related by our correspondent:

"Bridges will wear out. The growth of a city often necessitates widening of its streets. This is what happened in Portland, Oregon—and hereby hangs a moving tale.

"The plans for the new Burnside Bridge called for a wide approach, with accompanying widening of streets on both west and east sides of the river.



A hotel in Portland, Oregon, in process of being moved

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Not overlooking the fact that to enjoy Nature's beauty to the utmost you must have comfortable beds, excellent food and the kind of service that is never obtrusive, but always effective.

That's what the Great White Fleet has to offer you when you plan your winter vacation, for it carries only first-class passengers and its service, food and accommodations are ranked with the best hotels ashore. "Every Passenger a Guest" means all that it says.

Twice every week—on Wednesdays and Saturdays—Great White Fleet ships sail from New York and New Orleans on cruises that last from 11 to 24 days—and the time to make your reservations for the winter cruise you have been planning is now—for south-bound travel is going to be unusually heavy.

—and remember that all shore trips, motor cars, launch excursions, railroad and hotel accommodations—everything done for your pleasure and amusement—is included in the price you pay for your ticket.

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On the East side loomed the Princess Hotel, weighing, the architects said, about 20,000 tons.

"There was only one thing to be done; the hotel must be moved. And in order for an additional story to be built and its doors to open on a level with the bridge approach, an elevation of fourteen feet was planned for the same time."

"On May 6 a Portland concern, employing sixteen men, began the arduous task of moving the hotel back 36 feet. Because of the unusually marshy ground at the rear, which gave poor support to the supporting anchors or "dead-men," around which the cables were wrapped, it is considered a remarkable feat that the four-story, concrete building was moved this distance with no mishaps beyond the breaking of several cables when anchors slipped.

"When the moving was completed, the logs that had formed the sliding ways were placed under the hotel, and the elevation began. The enormity of this task may be realized when it is stated that the men had to work by hand, pulling at long levers which were attached to jack screws.

"In less than a month the entire moving job was completed, with no casualties to occupants, furniture or equipment. It is rather an expensive proposition to move one's establishment intact, and is hardly practicable for a householder; but the moving of the Princess Hotel proves that it can be done!"

Marguerite Norris Davis.

Thanks!

The following letter warms the cockles of the make-up editor's heart. We would like to hear from other readers on this subject:

Dear Editor:

"Hamburger Literature" is so nearly universal in the modern periodicals that it is a great relief to the writer to read your August issue in which every article but one is continuous and complete without the personally, detested "continued on page —."

The writer wishes to assure you that he reads the matter in your issues from cover to cover and that he does not neglect your advertisers because the matter is not "hashed" and distributed through the advertising pages.

Doubtless if you had any way of canvassing the situation you would find a large number of equally appreciative readers.

Edward N. Lake.

Getting Down to Real Business

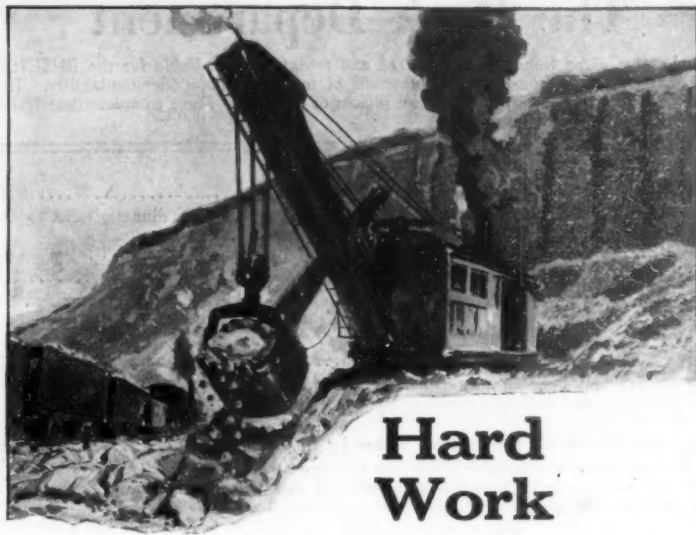
The erroneous impression seems to have become quite widespread that the Scientific American conducts a testing laboratory, and many people request us to make complicated tests on apparatus of all sorts. We have to refer these requests to some laboratory which does make a business of testing, and it is sometimes difficult to say which one is best suited to the particular and often peculiar piece of work in question. Therefore, it is interesting to us, and will doubtless be equally interesting to our readers, to learn that the Bureau of Standards has begun the compilation of a list of testing laboratories. This list is not yet ready, but the Bureau wants your help in making it complete. Here is what the Bureau writes us about it:

"The Bureau of Standards, Washington, D. C., is frequently requested to make tests of engineering materials for commercial organizations and individuals.

"In accordance with law, the Bureau makes many tests for other government departments. Due to the large amount of official work, it is the policy of the Bureau not to make tests for private individuals if other laboratories can do the work.

"In order to direct persons to laboratories equipped for tests, the Bureau is preparing a list of physical, chemical, and metallurgical laboratories.

"The Bureau will be glad to send a questionnaire to anyone who can give information about laboratories. Write to the Bureau of Standards, Washington, D. C., for the Questionnaire on Commercial Testing Laboratories."



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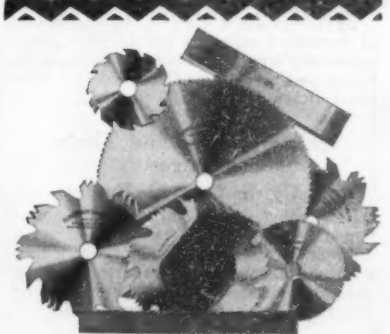
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The liberation of electrons by light and the photo-chemical actions of photography, etc., are given as the advanced lectures in physics at Kings College, London. Published by Longmans, Green & Co. \$6.70 postpaid.

The Metallurgy of Aluminium

By R. J. Anderson

An authoritative text covering all the phases of aluminium and its alloys. Broad in treatment and contents. A complete reference practically presented. Published by Henry Carey Baird & Co. \$10.00 postpaid.

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Gives directly without interpolation, logarithms to five places, of all five-place numbers, and conversely, with graphic table reading to four places. A revolutionary aid to calculations. Published by The Macmillan Co. \$1.55 postpaid.

[All the above books are obtainable from the Scientific American Book Department, 233 Broadway, N. Y. C.]

Science and Money

Hydro-electric Securities Strengthened by Technical Progress

By Chase Donaldson

BONDS of the better known water power companies are now selling at prices to yield in the neighborhood of 4½ percent. This low yield is an index of the high public regard toward these bonds. Such high regard, in turn, is not due entirely to the low money rates now prevailing, nor to the fact that utility credit is on a high plane; it is largely due to the secure position attained by the hydro-electric plants in the general scheme of electric light and power generation.

Influences that are largely technical or at least economic in nature have been responsible for the improved investment position of hydro-electric securities.

Federal policies have stimulated the exploitation of water powers; interconnection between systems has brought about the most effective use of hydro-electric power; the size of recent developments has brought about a somewhat lower investment per unit of capacity; and technical improvements have helped to use more efficiently the power of falling water.

O. C. Merrill, formerly Executive Secretary of the Federal Power Commission, has asserted that we are in the greatest period of water power development ever known. A large measure of credit for the situation lies with the Federal water power act, passed by Congress in 1920, which allows Federal and state lands to be exploited by private companies under long term leases. Since 1920, projects totaling in the millions of horsepower have been completed or are under construction and the Commission has issued permits and licenses for many millions of additional horsepower.

Public utility people, of course, believe that private development of public resources is the more desirable and appear to have availed themselves of the liberal provisions of the water power act. Entire agreement, however, has not been reached between the Federal and state authorities but the Federal Power Commission has adopted the attitude that its function is to recommend policies and projects to the states, not to dictate action. Progress has certainly been made toward the harmonious consideration of problems by states, by the Federal Government, and by the public utility companies.

Standby Steam Stations Essential

Interconnection of water power and steam power plants has gone far towards utilizing the water power to the best advantage. A misconception of the position of water power in the total power supply of the country is likely to arise unless the actual facts are known. For example, the percentage of hydro to the total power capacity installed has been diminishing these last few years, due to the growth of the enormous steam central stations in the large congested centers and at the mouths of the mines.

To quote the late John A. Britton before the National Electric Light Association: "It is not to be expected, however, that the present industrial centers will be able to reduce their coal consumption, even assuming a complete utilization of all of their water powers. Over 40,000,000 horsepower is being developed today from coal, and in the congested industrial section of the United States today there is, according to government surveys, a little over 4,000,000 or 10 percent of maximum water power available to the total demand."

The influence of hydro stations upon the various super-power schemes has been rather overstated than otherwise. Standby steam stations are very nearly essential to hydro operation, to guard against periods of drought; and interconnection of several

plants is necessary to obtain the benefit of diversification of stream flow and of the variable power demands occurring in widely separated regions. In each of the major state divisions which now have a super-power system on a relatively small scale—this principle is recognized and carried out.

The part that steam stations play, even in a system that is predominately hydro-electric, is well illustrated by the experience of many southern companies during the recent drought when recourse was had to steam generated power.

After all, the earnings over a period of years available for bond interest and dividends are what determine the merits of any public utility security. But we must get behind the actual earnings to find what circumstances and conditions insure their continuance. That a small, isolated hydro system, with but a moderate water storage capacity, may be a very poor investment, is a natural conclusion. Incorporated in a system, its value is much higher. The primary question, however, takes us back to the relative costs of construction of steam and hydro plants, and their accessibility to the load.

Economy of Hydro Projects

To secure water storage and a sufficient "head" or drop, expensive dams and auxiliary works, roads to inaccessible mountain regions, long transmission lines—all have to be constructed. This fact alone runs the cost of hydro projects over that of steam. But when the plants are in operation, the hydro gains by the lessened cost of operation over the steam plant, with its large bills for labor, coal and supplies. However, hydro power is only economically superior to steam when the decreased costs of operation offset the increased interest charges on the larger investment. Hence, in comparing two companies of similar capacities and general characteristics, we must consider whether the ratio of operating expenses plus interest charges to gross earnings is larger for the steam or the hydro company.

In a purely hydro company, too, these total expenses are fairly constant, which indicates that the company should maintain as high an output as possible day in and day out to decrease the cost per unit of output. For this reason, hydro plants and large economical steam plants are more and more being used as "base load" plants with smaller, less economical stations to take the "peaks." That is why companies like the Niagara Falls Power Company that attract electro-chemical companies and others with a twenty-four-hour load can show such low costs—and sound investment ratings.

The size alone of some of the hydro-electric developments now in progress is indeed startling. The utilization of the Colorado River requires the joint action of four states; the Alabama Power Company is building six dams on the Tallapoosa River; the San Joaquin Light and Power Company station will have a head of 2,400 feet—higher than anything that has been attempted; the Pitt River chain of power houses will ultimately furnish 670,000 horsepower; and the Big Creek-San Joaquin project of the Southern California Edison Company will have an ultimate capacity of 1,407,000 horsepower. Although the initial investment in some of these developments appears unduly high in dollars, when referred to the unit of capacity in horsepower the investment actually becomes lower than that for many of the smaller developments.

As to the actual technical improvements which have enabled the companies to generate electricity more efficiently from water



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CONTENTS DECEMBER 1925

ARTICLES

The Air Races of 1925—By Prof. Alexander Klemm.....	365-368
Is the Universe Running Down?—By Henry Norris Russell, Ph.D.....	369
My Doubts About Spirit Photographs—By Walter Franklin Prince.....	370-371
Our Point of View—Editorial.....	372
Tragic Loss of the Submarine S-51.....	373
Man Is What He Eats—By Prof. Rudolph M. Binder.....	374-375
The Constitution Saved by Canvas Sea Anchors—By William H. Woodwell.....	376
Veterinary Department of Western University—Page of Photographs.....	377
Does a Radio "Roof" Top the World?—By Orrin E. Dunlap, Jr.....	378-379
The Progress of Medical Science—III—By Morris Fishbein, M.D.....	380-381
Plating Rubber, Just Like Metal—By D. H. Killefer.....	382-383
The Arrival of the Boat-tail Bullet—By Captain Edward Crossman.....	384-385
A Machine That is More Than Human—By Albert A. Hopkins.....	386-397
What Becomes of Your Railroad Fares.....	388-389
Bridge to Span the Grand Canyon—By Lewis R. Freeman.....	390-391
Buried Treasure—By Albert G. Ingalls.....	392-393
Naturalizing the Chinchilla—By John L. Von Blon.....	394-395
From the Scrap-book of Science—Two Pages of Photographs.....	396-397

DEPARTMENTS

Inventions New and Interesting.....	398-400
Recently Patented Inventions.....	401-402
News for Inventors.....	401
Scientific American Digest.....	403-406
Learning to Use Our Wings—A Department of Aviation News.....	408-420
Radio Notes.....	421-427
In the Editor's Mail—Where Reader Meets Reader.....	428-429
Science and Money—Hydro-electric Securities Strengthened by Technical Progress.....	430-431
The Heavens in December.....	431

INDEX TO ADVERTISERS

American Patent Protection Corp.....	408	Metallic Sign Letter Co.....	427
American Pipe Bending Machine Co.....	418	Midwest Radio Corporation.....	421
American Sheet and Tin Plate Co.....	412	W. & D. Mosey.....	412
American Telephone and Telegraph Co.....	427	Montgomery Ward & Co.....	417
American Tobacco Co.....	Back Cover	Moore & Company.....	428
Arguto Oilless Bearing Co.....	425	Munn & Company.....	418-424
Asia Publishing Co.....	428	National Carbon Co.....	418-419
Attorney, Box 164.....	410	National Radio Institute.....	421
Auto Accessory Manufacturer.....	428	Nicholson File Co.....	423
Francis Bannerman Sons.....	410	Benjamin H. Ocker.....	428
W. F. & John Barnes Co.....	428	Packard Motor Car Co.....	362
Harold M. Bennett.....	427	Parks Ball Bearing Machine Co.....	417
W. B. & J. E. Boice.....	432	J. Preleuthner.....	427
Bradley Polytechnic Institute.....	428	Radio Corporation of America.....	405
Broderick & Bascom Rope Co.....	429	Schwerdtle Stamp Co.....	417
Camera Craft Publishing Company.....	432	Scientific Apparatus Corp.....	412
Chicago School of Watchmaking.....	427	Arthur Sharman.....	427
Chicago Stock Gear Works.....	428	Sheet Steel Trade Extension Committee.....	413
Cortez Cigar Co.....	421	Simonds Saw & Steel Co.....	414
Crown Fuel Saver Co.....	417	Skayef Ball Bearing Co.....	361
Davey Tree Expert Co.....	427	Skinner Bros. Mfg. Co.....	410
Dayton Steel Foundry Co.....	412	South Bend Lathe Works.....	418
J. C. Dorn.....	421	Speedee-Heat Electric Furnaces.....	427
F. J. Drake & Co.....	428	Stephenson Laboratory.....	412
Eagle Radio Co.....	420	Stewart Iron Works Co.....	412
Evanahire Hotel.....	427	Taylor Instrument Companies.....	408
Fate-Root-Heath Company.....	422	Timken Roller Bearing Co.....	Third Cover
Federal Motor Truck Co.....	364	Uniaol Manufacturing Co.....	421
Firestone Tire & Rubber Co.....	432	United Fruit Company.....	420
Florsheim Shoe Co.....	424	United States Gypsum Co.....	423
General Electric Co.....	Second Cover	F. Vandervoort.....	421
General Motors Corp.....	408	Veeder Manufacturing Co.....	422
Globe-Wernicke Co.....	418	Vilter Manufacturing Co.....	428
Harper & Brothers.....	417-426	Western Electric Co.....	409
Ray Hibbler.....	429	Westinghouse Electric & Mfg. Co.....	415
Hollywood Film Co.....	421	Weyerhaeuser Forest Products Co.....	411
Hotel Chase.....	429	White Company.....	411
Hotel Fort Shelby.....	417	J. L. Whiting-J. J. Adams Co.....	410
Hotel Marquette.....	410	Wisconsin Electric Co.....	416
Huther Bros. Saw Mfg. Co.....	429	Witts Engine Works.....	412
Languages Publishing Co.....	429	Wood Shovel & Tool Co.....	416
Lorraine Hotel.....	432	Henry Zehr, Inc.....	412
Manufacturer.....	412		
Metal Cast Products Co.....	421		

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